DUST CONTROL AND AIR QUALITY MONITORING PLAN FOR REMEDIAL ACTION AT MIDNITE MINE SUPERFUND SITE, STEVENS COUNTY, WA

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Stevens County, WA

1.0 INTRODUCTION

Midnite Mine is an inactive, open-pit, hard rock uranium mine. It is located in the state of Washington approximately 40 air miles northwest of Spokane and 8 air miles northwest of Wellpinit, as shown on Figure 1-1. The mine is situated entirely within the 154,000-acre Spokane Indian Reservation. Access to the mine is via gravel roads leading off the paved Ford-Wellpinit Road.

Midnite Mine was operated by the Dawn Mining Company, LLC (DMC) from 1955 through 1981, except for a four-year hiatus from 1965 to 1969. Mined uranium ore was transported by truck approximately 12 air miles east to the DMC mill. The former mine lease area, identified as the DMC lease area, encompasses approximately 811 acres (SMI 1996), of which 350 acres (an area approximately 0.5 mile wide by 1 mile long) were disturbed during mining operations. Newmont USA Limited now holds the majority interest in DMC; those two entities are referred to hereafter in this document as "the Companies."

The past mining of uranium at Midnite Mine has resulted in releases of naturally-occurring radioactive compounds, metals and other substances into surface material, sediment, surface water, groundwater, and air at and around the mine. Previous investigations of the mine and surrounding area provide some documentation of contaminant concentrations and their potential migration. The most notable features present at the inactive mine today include haul roads, waste rock piles, protore piles, two open pits, a seep collection system, pollution control pond (PCP), mine buildings, and a water treatment plant (WTP). Less visible are areas of waste rock fill, including the backfilled pits. The Remedial Action (RA) involves the cleanup of contaminated mine waste and groundwater associated with this former mine.

In 2012, the U.S. Environmental Protection Agency (EPA) issued a Consent Decree (U.S. EPA Consent Decree, Civil Action No. CV-05-020-JLQ, January 17, 2012) specifying remedial activities that must be performed at the Midnite Mine site. The Companies are taking this action as required by the Consent Decree in accordance with the Statement of Work for Remedial Design/Remedial Action (SOW), which is Appendix B to the Consent Decree and with the Midnite Mine Superfund Site Record of Decision (ROD; EPA 2006). They include 1) excavation of above-grade mine waste, 2) consolidation of above-grade mine waste into two existing pits, and 3) contouring of wastes in those pits and construction of a stable vegetated cover. Those activities have the potential to generate fugitive dust containing a variety of metals, radioactive materials and other potentially hazardous substances. In response, this ***Dust Control and Air Quality***

Monitoring Plan for Remedial Action at Midnite Mine Superfund Site (DCAQMP) was developed to minimize and mitigate potential impacts from those activities.

1.1 Purpose

The purpose of the DCAQMP is to identify methods and procedures that will be used to monitor and minimize fugitive dust emissions from remediation activities. Monitoring will be accomplished using visual emission opacity observations and deploying a network of fixed and roving monitors to provide real-time particulate data that can be accessed remotely. A variety of controls will be implemented to minimize emissions from remediation activities, with goals of 1) no visible dust emissions and 2) no measured airborne particulate concentrations exceeding thresholds indicating potentially hazardous concentrations of one or more Contaminants of Potential Concern (COPCs). The DCAQMP also specifies actions to be taken should either of these goals not be met at any given time.

1.2 Applicability

This DCAQMP applies to all “on-site” remediation activities describe in the Midnite Mine Superfund Site 100 Percent Basis of Design Report (BODR) (MWH, 2015). Dust control and monitoring requirements for “off-site” areas such as the (b) (6) Borrow Area are addressed in the (b) (6) Property Plan of Operations and Reclamation, Revision 2, included in the BODR.

1.3 Objectives

Objectives of the DCAQMP can be broadly categorized as 1) ensuring compliance with federal regulatory requirements during remediation activities, and 2) providing an added measure of protectiveness to on-site workers and the public using a real-time monitoring network. The objectives are summarized below.

1.3.1 Regulatory Objectives

Activities set forth in the DCAQMP will ensure compliance with the following regulatory requirements:

- Federal Air Rules for Reservations (FARR) in Idaho, Oregon and Washington set forth in 40 CFR Part 49 (FARR 2005). These rules include requirements to take reasonable precautions to prevent fugitive particulate matter emissions; places opacity limit of visible emissions from stationary sources; and requires annual monitoring. EPA Methods 9 and 22 are used to determine the presence of visible emissions and the level of opacity. Forestry and silvicultural activities as well as emissions from fuel combustion in mobile sources are exempt from FARR requirements.
- EPA General Permit for New or Modified Minor Source Stone Quarrying, Crushing and Screening Facilities in Indian County (EPA 2015), (Appendix A). Although the

remediation is exempt from permitting under CERCLA, the permit conditions are applicable.

- Personal air monitoring associated with worker health and safety is addressed by OSHA regulations and is described in the Remedial Action Health and Safety Plan (included as Appendix L of the BODR, MWH 2015); those activities are not addressed in this document. However, data collected from that monitoring may be used to re-evaluate ambient monitoring data collected pursuant to this DCAQMP and the appropriateness of the calculated total suspended particulate (TSP) trigger levels.

1.3.2 Non-Regulatory Objectives

A number of activities identified in this DCAQMP are not required by regulation, but are being implemented voluntarily to achieve additional objectives including:

- Provide additional protection for on-site workers.
- Provide additional protection for the surrounding off-site population.
- Minimize the off-site transport of airborne contaminants.
- Enable dust control efforts to be targeted in areas where they will have the most impact.
- Evaluate the effectiveness of on-site dust control procedures and support fugitive dust control efforts.

A primary benefit of the non-regulatory program is that it detects and alerts on-site personnel to developing fugitive dust problems and potentially hazardous COPC concentrations in real time, rather than relying on laboratory data received long after the fact. This allows for effective, timely implementation of enhanced dust control measures. The EPA and the Tribe will be notified by the Supervising Contractor of any actionable TSP exceeding the trigger level within 24 hours and the actions that were taken to reduce the dust levels.

1.4 Approach

This DCAQMP presents a detailed approach for achieving the regulatory and non-regulatory objectives listed above, as summarized below:

- Section 2.0 (Regulatory Requirements) briefly describes the history of the Midnite Mine and discusses the applicable regulatory requirements and their implications for remediation activities.

- Section 3.0 (Remedial Action Master Dust Control Plan) describes general dust suppression measures that will be employed for all activities and those specific to various activities such as excavating, hauling and crushing/screening of materials. Additionally, site-specific dust control practices will employ Best Management Practices (BMPs) to control fugitive particulate matter from activities associated with specific sites.

- Section 4.0 (Non-Regulatory Air Quality Monitoring) describes the process used to establish ambient particulate trigger levels, and the voluntary quality monitoring program that will be implemented to provide an additional level of protection, including:
    - Real-time particulate and meteorological monitoring during remediation activities (Sections 4.5.1 and 4.5.2);
    - Real-time alarming and notification of appropriate on-site personnel to ensure appropriate response actions (Section 4.5.4).

- Section 5.0 (Regulatory Monitoring) describes emissions monitoring that will be performed to satisfy the applicable regulatory requirements. This includes:
    - Quantitative testing of engine emissions to verify compliance with applicable carbon monoxide emission limits;
    - Evaluation of visible emissions from stationary sources using EPA Method 9 (Section 5.1);
    - Evaluation of fugitive emissions using EPA Method 22 (Section 5.2).

The DCAQMP includes Standard Operating Procedures for the particulate monitoring system, the meteorological system and the real-time alarming and notification system (Appendix B), as well as the procedures and forms used to perform the required EPA Method 9 and Method 22 emissions evaluations (Appendices C through E).

1.5 Roles and Responsibilities

Figure 1-2 shows roles and responsibilities for implementing the DCAQMP:

- Dust control activities will be implemented by the Construction Contractor in accordance with procedures and methodologies presented in Section 3.0 of the DCAQMP. Enhanced / additional dust control measures will be implemented as directed by the Field Engineer, who works under the direction of the Construction Quality Assurance Manager.

- The Field Engineer will conduct routine operation of the real-time monitoring network, and use that data along with personal observations to determine when additional dust control may be warranted.

- The Field Engineer will also conduct all regulatory air monitoring (Section 5.0), including opacity monitoring using EPA Methods 9 and 22.

- The Air Quality Assurance Contractor (AQAC) will perform the following functions:

    - Initial installation of the real-time monitoring network;
    - Train Field Engineer on network operations and provide ongoing technical support and advice as needed;
    - Monthly equipment calibrations, including maintenance and repairs as necessary;

- o Real-time monitoring data management;
- o Quarterly data reporting, including results of regulatory air monitoring conducted by the Field Engineer.

1.6 Other Issues

Potential for Public Exposure

Access to construction areas on the Midnite Mine will be strictly controlled by fencing and the use of limited access points. However, it will be possible for the public to access the surrounding area up to the mine fence; primarily for recreational and traditional uses such as hunting, gathering, off-roading and hiking on an occasional basis. Worker exposure limits are general based on 2,000 hours/year exposure – considerably more than would be experienced by an occasional public visitor. Therefore, the approach proposed in this DCAQMP is considered protective of the health of the visiting public.

The site is fairly remote with respect to inhabited areas. The community of Wellpinit is located approximately 8 miles to the southeast and the nearest permanent residence is approximately 3 miles to the southeast.

Regulation of Radioactive Materials

With the exception of the Water Treatment Plant (WTP), the Midnite Mine (including the entire remediation area addressed by the DCAQMP) does not contain radioactive material subject to the Nuclear Regulatory Commission (NRC) or Washington State regulatory requirements. Washington has entered into an agreement with the NRC to regulate the use of radioactive materials within the state. The Washington Department of Health (WDOH) issued Midnite Mine a Radioactive Materials License (RML) to Dawn Mining for the WTP; that license was terminated on December 31, 2008. All aspect of the terminated license remain in effect under the EPA Consent Decree. The WTP residuals are managed, stored and disposed of in accordance with the license conditions in the terminated WDOH license. The WTP residuals do not include air emissions and the WDOH RML did not include conditions for monitoring emissions from the WTP residuals except as required for occupational radiation protection.

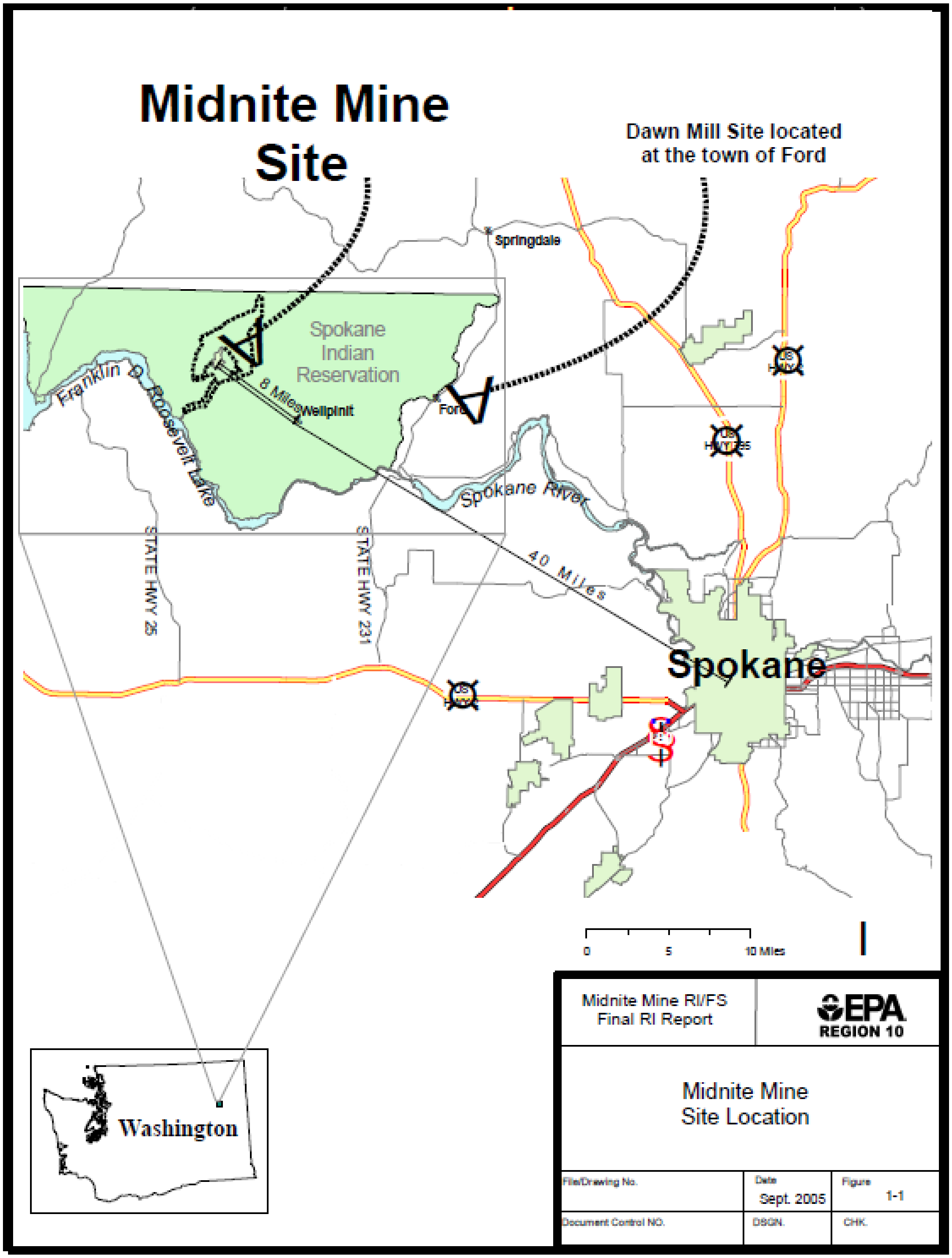


Figure 1-1: Midnite Mine Site Location

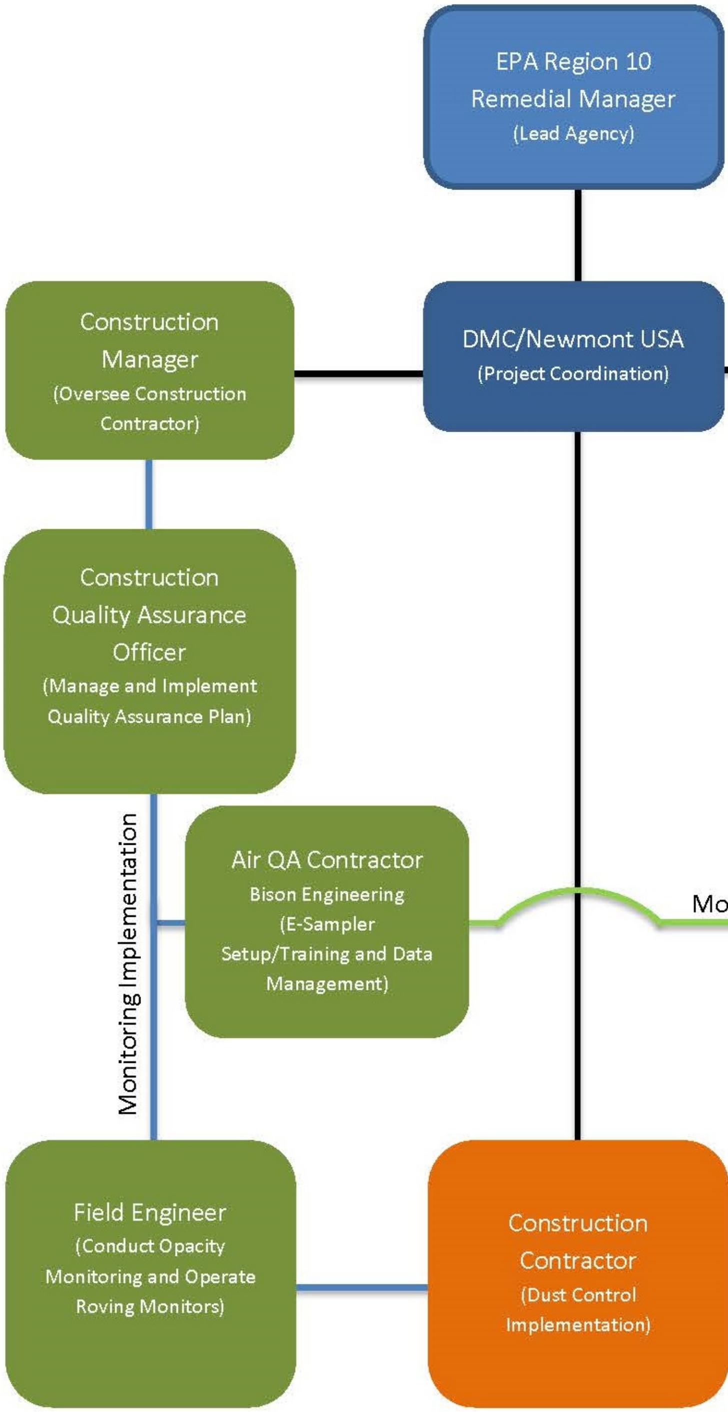


Figure 1-2: Organization Chart for DCAQMP Activities

2.0 REGULATORY REQUIREMENTS

Air emissions will primarily consist of fugitive dust from the movement of mine waste and soil material during the Remedial Action (RA). This *DCAQMP* is one of many work elements that have been developed and implemented pursuant to the remedial actions set forth in the ROD and the Consent Decree SOW. The RA primarily involves the consolidation and disposal of contaminated material in the Waste Containment Area (WCA) that will be hydraulically isolated from surface and groundwater. The groundwater will be pumped and treated at the water treatment plant, and the treated effluent will be discharged into Lake Roosevelt. A more detailed description of the selected remedy for the Midnite Mine is presented in the 100 Percent Basis of Design Report (MWH 2015).

As described in the Federal Air Rules for Reservations (FARR) in Idaho, Oregon, and Washington set forth at 40 CFR Part 49 (FARR 2005), the owner or operator of any source of fugitive particulate matter emissions located on Indian lands is required to take reasonable precautions to prevent fugitive particulate matter emissions and to maintain and operate the source to minimize these emissions. Facilities subject to the FARR are required to have a written plan describing the reasonable precautions that will be taken to prevent fugitive particulate matter emissions, including appropriate monitoring and recordkeeping, and then to implement that plan. This DCAQMP fulfills this FARR requirement of preparing a written plan describing the reasonable precautions. Reasonable precautions are described in the FARR (see excerpts in Table 3 of WME 2015). Tribal New Source Review provides specific limitations of regulated pollutants that are described and evaluated in the Air Emissions Inventory and Regulatory Analysis (WME 2015). The current specified equipment to be used during the RA would not exceed these limits (WME 2015).

The EPA General Permit for New or Modified Minor Source Stone Quarrying, Crushing and Screening Facilities in Indian Country (SQCS General Permit) was established on April 17, 2015, and implemented beginning May 17, 2015. The SQCS General Permit is provided in Appendix A. Although on-site RA activities are exempt from permits, the substantive requirements of the SQCS General Permit include specific operations, maintenance, and monitoring that would limit emissions from stationary sources and fugitive dust. These substantive requirements will be implemented in the rock crushing area and include specific material processing and fuel limitations, dust control practices, equipment maintenance frequencies, monitoring, corrective actions, recordkeeping, and reporting requirements. The full list of SQCS General Permit substantive requirements is provided in Section 4.0 of WME 2015.

In addition to the regulatory requirements described above, two planning documents prepared on behalf of the Companies provide additional detail on dust control and management, including:

- Midnite Mine Superfund Site 100 Percent Basis of Design Report (BODR), prepared by MWH in 2015, and
- Air Emissions Inventory and Regulatory Analysis, submitted by Worthington Miller Environmental, LLC in December 2015.

This DCAQMP incorporates Best Management Practices (BMPs) to control fugitive particulate matter (PM) as described in the BODR. Additionally, this DCAQMP specifies that visible emissions from stationary sources will be monitored in accordance with EPA Method 9 and fugitive particulate matter (PM) emissions with EPA Method 22. Both methods will be performed within 30 days of the start of operations, and on an annual basis thereafter with new surveys conducted when a new source or new operation commences, during typical operating and weather conditions (as required by 40 CFR Part 49.124 and 49.126). The date, time, and results of both tests will be documented. Additionally:

- If visible emissions from stationary sources exceed the 20 percent opacity requirement, an action plan will be prepared to identify sources and actions to prevent exceedance.
- If fugitive PM emissions are identified, measures will be taken to minimize fugitive emissions.
- Reasonable measures will be employed on-site to achieve EPA's directed goal of "No Visible Emissions" (WME 2015).

In addition to this DCAQMP, the selected RA Contractor will prepare the site-specific dust control plan that will be included as part of the Remedial Action Work Plan (RAWP) for the Site. The site-specific dust control plan will be updated as the various RA activities progress.

3.0 REMEDIAL ACTION MASTER DUST CONTROL PLAN

3.1 General Dust Suppression Measures

Dust generation is a primary concern during site earthwork, including activities such as excavating, hauling, crushing, screening, and placing of a variety of materials including overburden, rock, and soils. At the Midnite Mine site, these activities are being performed as part of the selected remedy identified in the Record of Decision (ROD). Primary aspects include:

- Excavation of above-grade mine waste. Waste to be excavated includes waste rock, ore and protore, stored mine cores, road gravel, contaminated soil, and pit and drainage sediments.
- Consolidation of the excavated mine waste in Pit 3 and Pit 4 to create waste containment areas with a sump, drainage layer, and liner to channel groundwater entering the pits around the waste and into the sump at the bottom.
- Contouring the waste in Pits 3 and 4 and waste in the backfilled pit area (BPA) and construction of a stable vegetated cover designed to minimize surface water infiltration and meet radon and radiation cleanup levels for each waste containment area.
- Removal of haul roads and cleanup of drainage areas.

During remediation a primary goal is to maintain “No Visible Emissions” during RA activities. Proactive dust control measures will be taken to mitigate the potential sources of the dust as described in this Plan. Generally, the dust control measures will include:

1. Dust suppression at emission points on stationary equipment.
2. Watering or chemical dust suppressant applications on unpaved haul roads and operating at reduced vehicle speeds.
3. Direct application of water and/or biodegradable dust suppressants (e.g., lignin sulfonate) onto soils, work areas and dirt roads as necessary to control dust.
4. Utilizing water sprays at the point of soil excavation or deposit by equipment such as excavators and dump trucks.
5. Watering to moisten large areas that will be disturbed by construction equipment.
6. Spraying water or a non-toxic soil stabilizer on exposed wind-movable soils prior to short periods of inactivity, and using dust suppressants prior to extended periods of inactivity.
7. To minimize water use, organic dust suppression additives such as lignin sulfonate may be used during demolition and construction activities.
8. Stockpiles will be enclosed, covered, watered (as needed), or non-toxic soil binders applied as needed to control dust.
9. Natural or artificial windbreaks will be used as necessary to control fugitive dust for small dust sources.
10. A non-toxic soil stabilizer will be applied to inactive areas or the areas will be watered as needed to control fugitive dust as described in item D of Section 1.3 –

Dust Abatement, Part I – General, Temporary Environmental Controls, in Appendix K – Technical Specifications in the BODR.

11. Operational BMPs, such as minimizing the drop distance at each material transfer point, will be implemented to minimize fugitive dust.

If dust is observed during remedial action activity, these measures will immediately be increased in frequency and/or intensity to mitigate dust at the source areas. In addition, these measures will be re-evaluated if the actionable TSP trigger level of 260 micrograms per cubic meter (µg/m^3)(developed in Section 4.2.4.3 of this document) is exceeded based on on-site real-time monitoring, or if visual observation suggests that dust control is not effective. Re-evaluations of the TSP trigger level will include the use of contaminant-specific measurements of air samples in order to justify the potential use of higher trigger levels. Also, data obtained from air samples used to evaluate personal worker health and safety will be used for any needed re-evaluation the TSP trigger level, addressed in the Remedial Action Health and Safety Plan in Appendix L of the BODR.

Water and/or dust suppressants will be applied in sufficient quantity to control dust, but not generate free liquids. Water which meets the Clean Water Act primary and secondary drinking water maximum contaminant levels (MCLs) will be used for dust suppression in uncontaminated areas. Treated water from the WTP can be used for dust control on contaminated materials [specifics are provided in Appendix T (Water Source Identification and Development Plan) of the BODR]. Dust suppressant chemical treatments will be used only if necessary and then only after approval of the EPA and Spokane Tribe.

Dust levels will be monitored quantitatively and qualitatively by supervisory personnel certified to evaluate visible emissions and fugitive emissions in accordance with EPA Reference Method 9 (Visual Determination of Opacity of Emissions from Stationary Sources) and Method 22 (Visual Determination of Fugitive Emissions from Material Sources and Smoke Emissions from Flares). A certified individual will be on site any time excavating and hauling activities are occurring to monitor for visible dust. The project goal is for no visible dust to be generated (other than within a few feet of an excavator bucket, grader blade, or vehicle tire), and for no visible dust to leave the site. As described in the FARR, forestry and silviculture activities and emissions from fuel combustion in mobile sources are excluded from these requirements. The certified individual has the authority to direct site operations to rectify the dust-generating activity (e.g., reduce vehicle speeds, apply water or dust suppressant), and has the responsibility and authority to stop work until the dust problem is resolved.

3.2 Specific Dust Suppression Measures

The following sections describe dust suppression measures that will be employed for specific construction activities, including:

- Excavation and Grading
- Hauling of Material
- Crushing and Screening
- Stockpiles
- Material Dumping and Placement
- Scaling and Blasting
- Demolition
- Tanks
- Wind Erosion

3.2.1 Excavation and Grading

Areas disturbed during RA construction will be permanently stabilized as soon as practicable by placement of a clean, vegetated soil cover as described in BODR Appendix D - Mine Waste Excavation and Containment. Pending placement of the soil cover, soils in disturbed areas will be stabilized by reducing slope lengths with terracing and diversions, and by roughening the slope surface. More aggressive BMPs to temporarily stabilize soils (e.g., mulching) will be avoided to limit potential interference with verification sampling of surface soils to demonstrate achievement of cleanup levels.

Dust-suppressant water will be applied directly onto the disturbed areas and work areas with the use of a water truck or other methods of conveyance. Soil-Sement® (polymer emulsion dust suppressant) and/or hydro-mulch/seed will be applied to inactive topsoil areas and will be used to cover clean soil stockpiles to control fugitive dust (subject to EPA and Tribal approval).

3.2.2 Hauling

Water trucks will be used to apply dust control spray to unpaved areas so that material can be transported to its final destination without creating visible dust. Loading of trucks will be carefully monitored and water spray will be applied as needed to knock down dust generated during loading. If the haul load includes fine-grained materials, the contents of the truck will be wetted prior to hauling if deemed necessary to control dust during transport.

The permanent site access road will be paved. Temporary haul roads may be surfaced with imported durable aggregate materials should reduction of dust be required in heavier traffic areas. The New Site Access Road from the Westend-Wellpinit Road to the Construction Support Facilities will be paved to control fugitive dust as described in Attachment B-2 (Midnite Mine Remedial Action Pavement Design) to Appendix B (Construction Support Facilities and Early Works) of the BODR.

Water and/or biodegradable dust suppressants (e.g., lignin sulfonate) will be applied directly onto soils, work areas, and dirt roads as necessary to control dust as described in the BODR:

- Section 1.3 (Dust Abatement, Part I – General, Temporary Environmental Controls), in Appendix K (Technical Specifications)
- Section O5.5 Element #5 (Stabilize Soils) of Appendix O (Master Stormwater Management Plan)

To minimize water use, organic dust suppressant additives such as lignin sulfonate may be used during demolition and construction activities. Use of dust suppressants will be coordinated and approved by the EPA and Tribe.

Additionally, vehicles carrying materials to or from the site shall be secured and covered in compliance with both 40 CFR 49.126(d) and WAAC 173-400-040(9). This is further described in Appendix K (Technical Specifications) of the BODR, under Section 1.4 "Dust Abatement, Part 1 – General, Temporary Environmental Controls."

If vehicle track-out onto public roads develops, wheel washers will be used to control on-road dust and the paved road will be swept at the end of each shift as necessary with a Mobil Athey or similar water spray pick-up broom-type street sweeper as described in Section 1.3 – Dust Abatement, Part I – General, Temporary Environmental Controls, in Appendix K – Technical Specifications in the BODR.

3.2.2.1 Speed Limits

In general, a speed limit sign of 15 miles per hour or lower shall be posted at the borrow area (which is an off-site location) and rock crushing area so that it is visible to truck traffic in accordance with the SQCS General Permit and (b) (6) Borrow Area Plan of Operation and Reclamation (specific to the off-site borrow area). All other areas will have a maximum speed limit of 20 mph.

Speed limit and no-idle zone signs shall be posted on all on-site roads and haul roads, and will be designed to comply with Washington State Department of Transportation (WSDOT) requirements, including but not limited to, sign size, letter size, and post height. The size of lettering shall comply with the appropriate comprehension rate given for the speed limit in the WSDOT Traffic Manual and in accordance with Appendix K (Technical Specifications) of the BODR.

Lower speed limits may be necessary to control dust depending on actual day-to-day site conditions. Site supervisory personnel will enforce speed limits. Appropriate corrective actions will be implemented if equipment operators are observed to be operating equipment at excessive speeds.

3.2.2.2 Loading

Loading of trucks will be carefully monitored and water spray may be applied as needed to knock down dust generated during loading. Vehicles carrying materials to or from the site shall be secured and covered in compliance with 40 CFR 49.126(d) and WAC 173-400-040(9) as described in Section 1.4 – Dust Abatement, Part I – General, Temporary Environmental Controls, in Appendix K – Technical Specifications in the BODR.

Trucks leaving the site will be washed, swept or mechanically cleaned at identified decontamination sites prior to entering public roadways to prevent tracking of dust off-site.

3.2.3 Crushing and Screening

Mineral crushing and screening operations can be major sources of airborne dust due to the inherent nature of size reduction and segregation processes. Analysis of the sources, identification of appropriate control technologies, and consistent application and maintenance of selected controls is necessary to prevent dust generation.

Crushing, screening and placement of overburden materials may introduce a greater dust hazard than other areas on the site. The movement of these materials will be managed in order to prevent fugitive dust. Dust from these operations will be controlled through use of water trucks, water sprays, and/or manned water hoses.

The rock crusher units will be equipped with continuous wet dust suppression systems or ventilated abatement equipment (baghouse equipment) to control dust, including all crushers, screens, drop points, and other possible release points as described by the SQCS General Permit. The drop distance for developing storage/stock piles will be minimized as described in Appendix K (Technical Specifications) of the BODR.

Diesel particulate filters will be used on the rock crusher engines.

3.2.4 Stockpiles

During active stockpile construction, water will be applied directly to the stockpiles by spraying with monitor-equipped hoses and water truck sprays. If water application is insufficient to control dust generation, wind-fencing will be installed to reduce the wind velocity in these areas and suppress dust generation. Additionally:

- Stockpiles will be enclosed, covered, watered (as needed), or non-toxic soil binders applied as needed to control dust as described in Item B of Section 1.4 – Dust Abatement, Part I – General, Temporary Environmental Controls, in Appendix K – Technical Specifications of the BODR.
- Stockpiles remaining after the construction season will be stabilized with seed and hydromulch to control dust emissions.
- Soil-Sement® (polymer emulsion dust suppressant) and/or hydro-mulch/seed will be applied to inactive topsoil and cover soil stockpiles to control fugitive dust as described in Section O5.5 Element #5: Stabilize Soils of Appendix O – Master Stormwater Management Plan in the BODR.

3.2.5 Material Dumping and Placement

Dust will be monitored during unloading or dumping of materials for crushing, screening and construction. Water spray will be applied as needed to control generated dust. Equipment operators will be trained on proper material handling methods to minimize dust generation. It should be noted that the SQCS General Permit specifically exempts dust generated by trucks dumping of nonmetallic minerals into any screening operation, feed hopper, or crusher from the opacity limits described in the permit conditions.

The cleared footprint will be limited to the area necessary for active construction as described in Appendix O (Master Stormwater Management Plan) of the BODR.

A non-toxic soil stabilizer will be applied to inactive areas, or the areas will be watered as needed to control fugitive dust as described in Section 1.4 (Dust Abatement) of Appendix K (Technical Specifications) of the BODR.

Erodible areas will be stabilized with non-erodible permanent material such as crushed aggregate, riprap, gabbions, etc., as described in the Stormwater Pollution Prevention Plan in Appendix K (Technical Specifications) of the BODR.

3.2.6 Scaling and Blasting

Hydraulic scaling will be used to reduce dust associated with the rockfall mitigation in the lower pit wall areas, as described in Appendix D (Mine Waste Excavation and Containment) of the BODR.

The contractor will prepare a General Blasting Plan that includes the control of dust as described in Section C (Blasting Plans) of Appendix K (Technical Specifications) of the BODR.

3.2.7 Demolition

A water truck will be used to wet haul roads from the specific demolition site to the temporary storage or disposal location as described in Section H.5.1 – Typical Demolition Equipment in Appendix H – Demolition of the BODR. The structures will be wetted to control fugitive dust during demolition, including the loading and dumping of debris as described in Section H.5.1 – Typical Demolition Equipment in Appendix H – Demolition of the BODR and Item B-Pollution Controls, Demolition of Appendix K – Technical Specifications of the BODR.

If asbestos is identified in the buildings to be demolished, Asbestos NESHAP (40 CFR §160.145) work practices will be implemented. Prior to demolition, the existing structures will be evaluated by a certified asbestos building inspector or other qualified professional. If asbestos is found, it will be removed. The Asbestos NESHAP requires notifications, material identification, control procedures for removal, adequate wetting, local exhaust ventilation, negative pressure enclosures, glove-bag procedures, high efficiency particulate air (HEPA) filters, waste disposal work practices, reporting and recordkeeping, and asbestos hazards and worker protection.

3.2.8 Tanks

The lime slurry system at the water treatment plant will utilize a baghouse filter system on the lime bin to control dust related emissions as described in Section 2.4.3 Lime Slurry System in the Operation, Maintenance and Monitoring (OM&M) Plan for the Midnite Mine Water Collection System and Water Treatment Plant for the Phase I RD/RA: Interim Water Management for the Midnite Mine, Revision 2 (Tetra Tech 2010) as attachment P-1 in the BODR.

The liquid propane tanks will be pressurized and will not be allowed to breathe or vent to the atmosphere.

3.2.9 Windblown Dust

Natural or artificial windbreaks will be installed as necessary to control fugitive dust for small dust sources as described on page 7 of Appendix O (Master Stormwater Management Plan) of the BODR.

Work and activity on excessively windy days will be restricted to control dust emissions as described in Appendix O (Master Stormwater Management Plan) of the BODR.

Disturbed areas will be revegetated in accordance with Section 02970 Revegetation in Appendix K – Technical Specifications of the BODR. Following soil stabilization, remediated areas will be seeded to establish at least 70 percent vegetative cover by native baseline perennial species, as described in Section 1.5 – Definitions of Part I – General of Section 01570 – Stormwater Pollution Prevention Plan, in Appendix K – Technical Specifications of the BODR.

The real-time air monitoring plan presented in Section 4.5 of this document will detect excessive dust problems and automatically alert site personnel if the ambient TSP concentration at any dust monitor reaches the trigger level of 260 $\mu g/m^3$. During extremely windy, dry conditions there is the possibility that no amount of dust control will keep ambient TSP levels below the trigger level. In those instances, a temporary halt to construction activities may be necessary.

3.2.10 Fire Prevention

All equipment will use spark arrestors and smoking will be limited to designated areas to help prevent fires and associated emissions as described in Section L3.4.11 – Fire and Explosion Hazards, of Appendix L – Remedial Action Health and Safety Plan in the BODR.

Methods for dealing with accidental fires and potential explosion risks are addressed in Section L3.4.11 – Fire and Explosion Hazards of Appendix L – Remedial Action Health and Safety Plan in the BODR.

A Wildfire Response Plan will be submitted as part of the Remedial Action Work Plan.

4.0 NON-REGULATORY AIR QUALITY MONITORING

Real-time air monitoring will be conducted by the Field Engineer during all remedial activities. The Field Engineer will also perform the regulatory air monitoring described under Section 5.0 (including opacity monitoring) of the DCAQMP and report to the Construction Quality Assurance Officer; both are employees of the Construction Manager. The Construction Manager oversees all construction activities performed by the Construction Contractor and is hired directly by the Companies in an independent oversight role. In contrast, the Construction Contractor performs the actual earth-moving and remediation activities at the site and implements the dust control measures.

Additionally, an Air Quality Assurance Contractor (AQAC) will be directly employed by the Companies to install the real-time monitoring network, provide ongoing training to the Field Engineer, repair and calibrate the monitoring equipment as required and perform the data management and quarterly reporting functions for all air monitoring activities. The AQAC will report directly to the Companies and will not be a subcontractor to the prime Construction Contractor. The AQAC is not directly involved in the regulatory air monitoring activities, but will include the results of those activities in the quarterly air monitoring reports.

This section of the DCAQMP describes a network of real-time particulate (TSP) air monitors, situated at appropriate locations around the Midnite Mine, which will be designed, installed and operated as part of this plan. The network will include air monitoring at a minimum of six locations, including three semi-permanent locations at the site perimeter (immediately adjacent to the Mine Fence) to detect potential off-site migration of dust emissions, and at least three roving air monitors located downwind of active construction areas to monitor ambient air quality on-site during remediation activities. No “off-site” background monitoring locations will be established, as the site perimeter monitor locations have been selected to detect potential off-site dust migration. The approximate locations of these real-time monitoring sites are described in this section and exact locations will be developed for each phase or geographic area of the RA, once the remedial Construction Contractor is selected and the sequence of work is established.

In addition to the real-time air monitoring network described in this section, EPA Method 9 will be used to monitor visible emissions from stationary emission sources with exhaust stacks and EPA Method 22 will be used to monitor the presence of fugitive particulate emissions (e.g., road dust). That monitoring is described in Section 5.0 of this document. Worker air protection and personal monitoring are addressed in the Remedial Action Health and Safety Plan (HASP) found in Appendix L of the BODR.

It should be emphasized that the purpose of the real-time air quality monitoring program is to provide an ***added*** measure of protection to on-site workers and the off-site public, and to alert the remedial Construction Contractor to air quality conditions that require additional / enhanced dust control measures, or – in extreme circumstances – the temporary cessation of work. It is ***not*** meant to substitute for, or to supersede, other air monitoring that is typically conducted in the course of remediation activities, such as personnel monitoring, radiation dose monitoring, emission opacity observations, or any other required monitoring.

Also, it should be emphasized that the TSP data collected by the monitoring network will not necessarily correlate with any fugitive dust opacity observations, because the correlation of airborne particulate concentrations with visual opacity is not consistent. The correlation between opacity and airborne particulate concentration is highly dependent on both the size and nature of the particulate matter. Both will be highly variable at the Midnite Mine due to the variety of material that will likely be encountered, and the degree to which it may be crushed or otherwise modified (i.e., opacity is not a reliable predictor of airborne particulate concentration and vice-versa).

4.1 Off-Site Air Quality Monitoring and Area Classification

The nearest existing ambient air quality monitoring site is the Wellpinit-Spokane Tribe $PM_{2.5}$ monitor, located approximately six miles southeast of the Midnite Mine site at 6208 Ford-Wellpinit Road. The monitor is owned by the Spokane Tribes and has been in operation since November 2006. It provides continuous (hourly) $PM_{2.5}$ data that may be accessed over the State of Washington’s Department of Ecology website. Data from this site are useful for characterizing $PM_{2.5}$ concentrations in the general geographic area of the Midnite Mine and will help to document air quality impacts from temporary regional sources such as wildfire smoke and agricultural activities. However, the monitor will be of little value for monitoring dust emissions from remediation activities because of 1) its geographic distance from the mine, and 2) the fact that most dust emissions are expected to consist of larger particles that would not be detected by a $PM_{2.5}$ monitor, which captures only particles smaller than 2.5 microns in diameter.

The Spokane Indian Reservation has been designated an Attainment Area that complies with the National Ambient Air Quality Standards (NAAQS) for all criteria pollutants. The nearest area that has fallen below the NAAQS is the Spokane metro area for ozone and particulate matter. However, air quality has since improved to comply with the NAAQS and is now designated a Maintenance Area. The Spokane Indian Reservation is designated as a Class I airshed, which is a designation reserved for the most pristine airsheds such as national parks and designated wilderness areas.

Because the Midnite Mine Site is located in a remote area of the Spokane Indian Reservation (approximately three miles from the nearest residence, eight miles from Wellpinit, and approximately 40 miles northwest of Spokane), impacts from off-site sources of particulate emissions are expected to be minimal under normal conditions. However, the site could occasionally be impacted by 1) smoke from nearby wildfires (as occurred during the summer of 2015), and 2) regional emissions associated with intensive agricultural activities such as plowing and burning.

Deployment of additional off-site monitoring is not proposed as a means of monitoring the effectiveness of the Companies’ dust control plan since ambient dust concentrations would rapidly decrease within a short distance from the emissions source under normal conditions. Instead, the Companies propose the robust real-time on-site monitoring program discussed in the balance of this section, which includes multiple monitors in the vicinity of remediation activities, plus three semi-permanent monitors along the property perimeter (adjacent to the Mine Fence) to detect off-site migration of dust emissions.

4.2 On-Site Air Quality Monitoring

This DCAQMP establishes both a non-regulatory and regulatory program for monitoring the ambient air quality on the site during remediation activities. Objectives of the non-regulatory program include:

1. Protecting the health and safety of on-site workers.
2. Protecting the health and safety of the surrounding population (off-site).
3. Minimizing the off-site transport of airborne contaminants.
4. Evaluating the effectiveness of the on-site dust control procedures and supporting fugitive dust control efforts.

The purpose of this plan is to define on-site air quality monitoring to accomplish these four objectives. In this plan, a greater emphasis is being placed on item 4, evaluating the effectiveness of the on-site dust control procedures because, if the on-site dust control procedures are adequate, items 1 through 3 will be effectively addressed. This on-site air quality monitoring program has been developed using the following process.

Existing soil and waste material data collected on and around the Midnite Mine Site was evaluated to determine potential maximum concentrations of contaminants of potential concern (COPCs) and the results were presented in the Midnite Mine Remedial Investigation Report (RI) (URS 2005). It is assumed that if soils or waste materials become airborne during remediation activities, the concentration of COPCs in the airborne materials would remain the same on a mass fraction basis. Maximum mass fractions of individual COPCs in soil and waste material were used to calculate threshold concentrations of airborne particulates that would correspond to ambient COPC levels of potential concern and action level triggers for onsite particulate monitoring. Section 4.2.4.3 of this Plan details these calculations. To provide an additional margin of safety, each initial trigger level calculation was subsequently divided by 10. For conservatism, the maximum particulate trigger levels were based on total suspended particulate (TSP), although ambient standards for TSP have been superseded by standards for particulate matter smaller than 10 microns (PM_{10}) and, more recently, particulate matter smaller than 2.5 microns ($PM_{2.5}$). It should be noted that nearly all of the regulatory workplace standards used for the trigger level derivations presented in Section 4.2.4 are based on ***total*** airborne COPC concentrations, rather than the amount present in the PM_{10} or $PM_{2.5}$ fractions. The calculated trigger level based on this COPC analysis was 385 µg/m^3.

From 1971 to 1987 the primary ambient standard for TSP was a 24-hour average concentration of 260 µg/m^3 and an annual average of 75 µg/m^3. Subsequent airborne particulate standards were based on the PM_{10} and $PM_{2.5}$ fractions, as discussed in detail in Section 4.2.4.3. However, the historical 24-hour TSP standard of 260 µg/m^3 is more relevant to this project for the reasons discussed above. To provide an added measure of protection, the 24-hour TSP standard (260 $\mu g/m^3$) will be used as a one-hour TSP trigger level for the on-site monitoring system described in Section 4.5.

In order to ensure that dust control measures are effective in maintaining airborne dust below this level, a network of a minimum of six real-time monitors to continuously monitor hourly ambient concentrations of particulates will be installed as described in Section 4.5. An automated alarming system to alert the Companies' representatives to potentially hazardous ambient dust and/or COPC concentrations will be developed to enable the Companies to take appropriate actions during remediation activities.

4.2.1 Historical Ambient Monitoring Data

Ambient monitoring was not performed around the Midnite Mine site during its active operation. The calculations of potential airborne concentrations of COPCs will be based on the soil and waste analysis data presented in Section 4.2.3 of this document.

4.2.2 Current Ambient Monitoring

No ambient monitoring is currently being performed in the immediate vicinity of the Midnite Mine. The nearest monitor is the Wellpinit-Spokane Tribe $PM_{2.5}$ monitor located approximately six miles to the southeast. Data from that monitor can be used to characterize regional $PM_{2.5}$ concentrations and to document unusual conditions associated with wildfire smoke and agricultural activities. However, data from that monitor will be of little use for quantifying impacts from Midnite Mine remediation activities.

The monitoring program proposed in this DCAQMP will be in place before remediation activities begin in the late spring of 2016.

4.2.3 Soil and Waste Analyses

Extensive sampling of soil and waste rock materials was performed on and around the Midnite Mine site between 1998 and 2001; the area has remained largely undisturbed since that time. Those samples were analyzed for an extensive suite of both radioactive and non-radioactive COPCs and the results were presented in the Midnite Mine Remedial Investigation Report (RI) (URS 2005). For purposes of this evaluation, a non-radioactive COPC was defined as any of those analytes with an airborne inhalation limit specified by one or more of the following common standards or guidelines: Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL), National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit (REL), and American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV). Each of these standards / guidelines is discussed in greater detail in Section 4.2.4 of this DCAQMP. All radioactive parameters analyzed have a derived air concentration (DAC) standard established by the Nuclear Regulatory Commission; therefore, each is considered a COPC. The DAC standard is also discussed in Section 4.2.4.1.

Areas sampled are described below and shown in Figure 4-1 (URS 2005):

Background Area A: This area is located on the north slope of Spokane Mountain, approximately 200 feet to the north of the mined area (Spokane Mountain is a local feature, not to be confused with Mt. Spokane located near the city of Spokane). It is considered representative of background conditions because it was unaffected by operations of the Midnite Mine and was chosen for its proximity to the mine, presence of uranium ore deposits at depth, and similarity of rock types and geologic structure.

Background Area B: This area is located approximately 550 feet to the northeast of the mined area, in a separate drainage basin within the quartz monzonite that locally contains uranium materials. It is considered representative of background conditions because it was also unaffected by Midnite Mine operations.

Mined Area: The mined area is located on the southern slope of Spokane Mountain. About 350 acres were disturbed by mining activity, excluding areas subjected only to mineral exploration drilling. The topography is complex, with elevations ranging from 2,400 feet above mean sea level (amsl) at the southern end to 3,400 feet amsl at the northern end.

Downwind Northeast Area: This area is adjacent to the northeast portion of the mined area and was likely to have been affected by windblown dust and/or downwind transport of COPCs from the mined area based on nearby meteorological data (see Section 4.5 and the wind rose in Figure 4-2). It consists of dense forest and open areas with brushes and grasses; portions have been logged in the past.

Downwind Southwest Area: This area is adjacent to the southwest portion of the mined area and is likely to have been affected by windblown dust and/or downwind transport of COCs based on nearby meteorological data (see Section 4.5 and the wind rose in Figure 4-2). It was not physically disturbed by mining operations and contains few access roads. It consists primarily of open grassy forest.

Haul Roads: The unpaved East Haul Road and West Haul Road lead from the mined area to the paved Ford-Wellpinit Road. Both were periodically resurfaced with gravel consisting of mineralized calc-silicate rock from the east side of Pit 3, located within the mined area of the site.

Areas Adjacent to Haul Roads: These areas were sampled because soils and other media located near these two haul roads may have been affected by movement of material from the roads and spills in transporting ore or sludge.

Results of soil and waste material analyses from these areas are summarized in Table 4-1 for non-radioactive COPCs and in Table 4-2 for radioactive COPCs. These tables summarize the ***maximum*** values of each contaminant found in each sampling area – whether from a surface or subsurface sample – since both surface and subsurface materials will be disturbed during remediation activities. This analysis included both composite and grab samples, since the objective is to establish trigger levels that are reliably conservative with respect to protection of both worker health and off-site exposure.

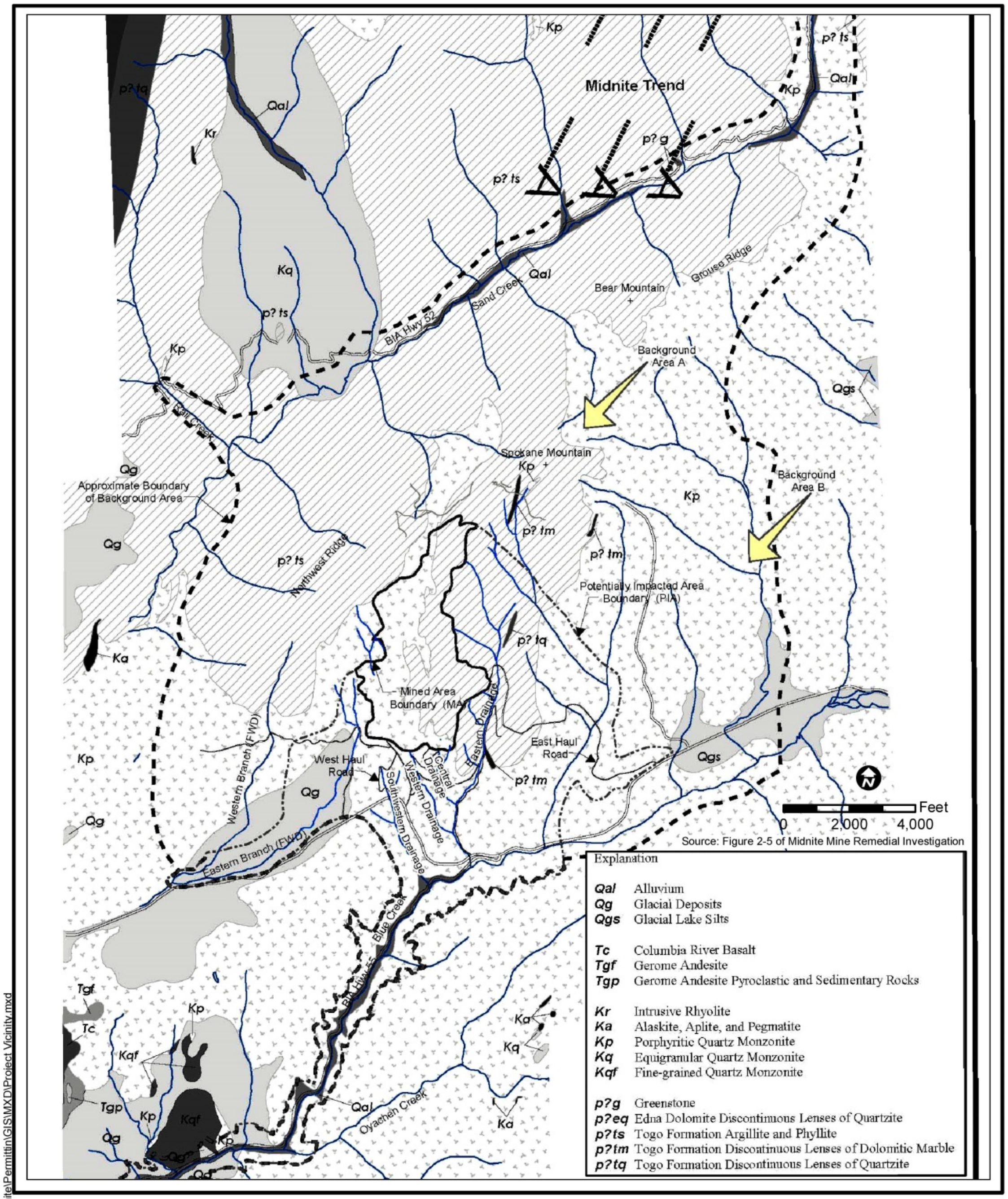
In both tables, the maximum overall value is bolded for each contaminant. Maximums for 18 of the 24 non-radioactive COPCs occurred in the Mined Area, with three occurring in Background Area A, two in the Downwind Northeast Area, and one in the Haul Road surface material. Maximums for ten of the eleven radioactive COPCs occurred in the Mined Area and one in the Haul Road surface material. Overall, maximums for 80% of the 35 identified COPCs occurred in the Mined Area.

The results presented in Tables 4-1 and 4-2 were used to determine the maximum potential fractions of each COPC that could be present in airborne dust resulting from the disturbance of materials during remediation. Those results then were used in Section 4.2.4 of this Plan to calculate airborne particulate concentrations that could indicate unacceptably high concentrations of those COPCs. It should be noted that hazardous threshold concentrations for a given COPC vary depending upon the route of exposure. For example, the hazardous threshold level for direct contact or ingestion may differ markedly from that associated with inhalation of airborne material. This Air Quality Monitoring Plan addresses only exposure to COPCs via inhalation; it is assumed that other exposure routes will be addressed via personnel monitoring, use of appropriate personal protective equipment (PPE), restricted site access and other measures taken pursuant to the site-specific health and safety plans.

4.2.4 Determination of Particulate Trigger Levels

The basic process used to determine particulate trigger levels is summarized below. Details of each step are provided in Sections 4.2.4.1 through 4.2.4.3.

1. Identify each COPC and the maximum measured concentration of each (as shown in Tables 4-1 and 4-2).
2. Determine an appropriate hazardous ambient concentration threshold for each COPC.
3. For each non-radioactive COPC, calculate the maximum COPC-to-particulate ratio; this is a dimensionless number that represents the fraction of the airborne dust that consists of the COPC in question.
4. For each radioactive COPC, calculate the maximum COPC-to-particulate ratio in units of picocuries per gram.
5. For each COPC, divide its hazardous concentration threshold by its maximum COPC-to-particulate ratio to determine the TSP trigger level that indicates a potentially hazardous airborne concentration. Then apply a safety factor of 10 to each result to provide an added margin of safety to both onsite workers and off-site communities.
6. The lowest TSP value obtained in Step 5 is then defined as the COPC-based TSP trigger level.



WORTHINGTON MILLER ENVIRONMENTAL, LLC.	Figure 4-1 Midnite Mine Study Area Geologic Map	Date: January 2016 Project: Midnite Mine File: Project Geology.MXD

Table 4-1: Summary of Soil and Waste Material Analyses – Non-Radioactive COPCs (all values mg/kg)

PARAMETER	BACKGROUND AREA A	BACKGROUND AREA B	MINED AREA	DOWNWIND NORTHEAST AREA	DOWNWIND SOUTHWEST AREA	ADJACENT TO HAUL ROAD	HAUL ROAD SURFACE MATERIAL
Aluminum	24,100	21,900	**33,700**	29,500	19,900	20,500	16,700
Antimony	1.30	1.40	1.30	**1.50**	1.20	1.20	0.86
Arsenic	234	3.30	**239**	50.5	5.50	64.2	92.4
Baruim	**384**	275	267	364	220	212	118
Beryllium	1.10	1.70	**6.41**	1.90	0.70	0.98	1.00
Cadmium	0.45	0.36	**3.50**	0.80	0.36	0.85	0.72
Calcium	8,670	6,150	74,800	8,550	4,850	34,800	**146,000**
Chromium	18.2	15.2	**66.0**	29.1	13.9	21.2	17.9
Cobalt	**23.8**	8.30	19.9	15.7	8.60	11.2	19.4
Copper	41.8	17.6	**83.0**	32.2	16.1	37.3	58.4
Iron	32,600	19,500	**65,300**	28,900	16,700	30,300	36,800
Lead	20.9	15.5	**84.0**	27.1	16.1	28.9	16.3
Magnesium	2,580	3,910	10,500	**13,900**	3,150	10,500	12,600
Manganese	1,640	1,170	**5,190**	1,990	652	1,160	1,100
Mercury	0.05	0.12	0.14	**0.17**	0.11	0.10	0.05
Molybdenum	3.40	0.80	**31.9**	1.60	1.80	4.40	7.40
Nickel	24.0	12.6	**44.0**	21.7	12.3	17.8	28.6
Phosphorus	**1,530**	602	577	653	462	444	397
Selenium	0.79	0.52	**90.0**	0.44	0.76	0.56	0.28
Silver	0.18	0.16	**1.18**	0.17	0.17	0.17	0.64
Sulfate	17.3	14.1	**2,655**	153	17.8	770	1,401
Thallium	0.30	0.30	**2.50**	0.20	0.17	0.24	0.49
Uranium	22.0	45.7	**482**	15.3	15.5	93.0	262
Vanadium	41.8	37.0	**132**	49.6	27.9	34.5	40.9
Zinc	62.4	55.2	**381**	116	58.1	71.3	90.3

Note: Highest concentration of each contaminant is shown in bold.
Note: For each area, values shown represent the maximum concentration of each contaminant found in each area, including both surface/subsurface samples and grab/composite samples collected between 1998 and 2001 (URS 2005).

Table 4-2: Summary of Soil and Waste Material Analyses – Radioactive COPCs (all values pCi/g)

PARAMETER	BACKGROUND AREA A	BACKGROUND AREA B	MINED AREA	DOWNWIND NORTHEAST AREA	DOWNWIND SOUTHWEST AREA	ADJACENT TO HAUL ROAD	HAUL ROAD SURFACE MATERIAL
Lead-210	11.0	5.50	**260**	8.30	5.50	45.0	70.0
Polonium-210	12.0	6.10	**320**	9.50	4.10	39.0	57.0
Radium-226	8.92	3.37	**880**	4.72	2.93	59.0	117
Radium-228	3.23	3.81	**7.66**	1.58	2.89	3.36	2.14
Thorium-227	0.536	0.459	**20.9**	0.363	0.281	2.09	1.48
Thorium-228	2.95	4.82	3.80	1.71	2.32	6.34	**13.7**
Thorium-230	8.68	3.55	**591**	5.44	2.48	40.6	121
Thorium-232	2.51	4.98	**10.9**	1.87	2.20	4.71	2.00
Uranium-234	7.99	19.5	**412**	5.33	5.07	51.0	82.7
Uranium-235	0.579	0.898	**18.9**	0.251	0.304	2.82	8.56
Uranium-238	7.30	15.2	**417**	5.11	5.18	51.0	86.8

Note: Highest value of each contaminant is shown in bold.
Note: For each area, values shown represent the maximum concentration of each contaminant found in each area, including both surface/subsurface samples and grab/composite samples collected between 1998 and 2001 (URS 2005).

4.2.4.1 Identify Hazardous Ambient Concentration Threshold for Each COPC

The first step in this process was to identify all potential COPCs. As discussed in Section 4.2.3, each non-radioactive analyte with an OSHA PEL, CAL/OSHA PEL, NIOSH REL and/or ACGIH TLV ambient standard or guideline was considered to be a COPC. These standards can be defined as follows:

- The **OSHA PEL** (permissible exposure limit) is a legal limit in the United States for exposure of an employee to a chemical substance or physical agent. Permissible exposure limits are established by the Occupational Safety and Health Administration (OSHA). For airborne COPCs, they are expressed as airborne concentrations (in units of milligrams per cubic meter, or mg/m^3) over an 8-hour averaging period.

- The **CAL/OSHA PEL** is analogous to the OSHA PEL, but was developed by the State of California. It is enforceable only in California and is lower than the OSHA PEL for some COPCs.

- The **NIOSH REL** (recommended exposure limit) is a level developed by the National Institute for Occupational Safety and Health (NIOSH) based on risk-based analysis. NIOSH believes this level would be protective of worker safety and health over a working lifetime, if used in combination with engineering and work practice controls, exposure and medical monitoring, posting and labeling of hazards, worker training and personal protective equipment. For most COPCs it is expressed as an airborne concentration in mg/m^3 over a 10-hour averaging period. It is not a legally enforceable standard.

- The **ACGIH TLV** (threshold limit value) of a chemical substance is a level to which it is believed a worker can be exposed day after day for a working lifetime without adverse health effects. These values were developed by the American Conference of Governmental Industrial Hygienists (ACGIH) and are expressed as airborne concentrations in mg/m^3 over an 8-hour averaging period. It is not a legally enforceable standard.

All radioactive analytes were considered to be COPCs because each has a derived air concentration (DAC) limit established by OSHA, which references and adopts the DAC developed by the U.S. Nuclear Regulatory Commission (NRC). The DAC is defined as, “The concentration of a given radionuclide in air which, if breathed by the reference man for a working year of 2,000 hours under conditions of light work (with an inhalation rate of 1.2 cubic meters of air per hour), results in an intake of one annual limit on intake (ALI). Established DAC values are given in Table 1, Column 3, of Appendix B to Title 10, Part 20, of the Code of Federal Regulations (10 CFR Part 20), *Standards for Protection Against Radiation*." The DAC for workers is used due to the fact that public receptors are not expected to be present at or near the site. Should a member of the public be present it would most likely be a recreational or customary/traditional user that would have a very limited duration of exposure. Residential receptors are far enough from the site boundary that air concentrations are anticipated to be diluted and dissipated to levels that, when using this worker-based standard at the boundary, would be below detection levels.

Next, a hazardous airborne concentration threshold was identified for each COPC for subsequent TSP trigger level analysis. Consistent with this DCAQMP's conservative approach, the lowest value among the OSHA PEL, CAL/OSHA PEL, NIOSH REL and ACGIH TLV limits was used for each non-radioactive COPC; those results (and their sources) are shown in the top portion of Table 4-3. DACs developed by the NRC were used for radioactive COPCs; those values are given in units of microcuries per milliliter of air volume and are shown in units of picocuries per cubic meter (pCi/m^3) in the bottom portion of Table 4-3.

Because those ambient thresholds apply to occupational or industrial exposure, a safety factor of 10 was applied to the initial trigger level calculations to ensure workers' safety, and further limit any potential exposure due to off-site migration of airborne contaminants.

Table 4-3: Ambient Concentration Limits Used For Trigger Level Analysis

COPC	Lowest Exposure Limit	Source
Metals and Inorganics		
Aluminum	1,000 µg/m^3	ACGIH TLV
Antimony	500 µg/m^3	All
Arsenic	2 µg/m^3	NIOSH REL
Barium	500 µg/m^3	All
Beryllium	50 µg/m^3	ACGIH TLV
Cadmium	2 µg/m^3	ACGIH TLV
Calcium	2,000 µg/m^3	CAL/OSHA, NIOSH, ACGIH
Chromium	10 µg/m^3	ACGIH TLV
Cobalt	20 µg/m^3	CAL/OSHA, ACGIH
Copper	1,000 µg/m^3	All
Iron	5,000 µg/m^3	NIOSH, ACGIH
Lead	50 µg/m^3	CAL/OSHA, NIOSH, ACGIH
Magnesium	5,000 µg/m^3	OSHA, CAL/OSHA, NIOSH
Manganese	20 µg/m^3	ACGIH TLV
Mercury	25 µg/m^3	CAL/OSHA, ACGIH
Molybdenum	500 µg/m^3	CAL/OSHA, ACGIH
Nickel	15 µg/m^3	NIOSH REL
Phosphorus	100 µg/m^3	All
Selenium	200 µg/m^3	All
Silver	10 µg/m^3	All
Sulfate	100 µg/m^3	CAL/OSHA PEL
Thallium	20 µg/m^3	ACGIH TLV
Uranium	50 µg/m^3	OSHA, CAL/OSHA, NIOSH
Vanadium	50 µg/m^3	CAL/OSHA, NIOSH
Zinc	2,000 µg/m^3	ACGIH TLV
Radioactive Isotopes[1]		
Lead-210	100 pCi/m^3	10 CFR Part 20 Appendix B[2]
Polonium-210	300 pCi/m^3	10 CFR Part 20 Appendix B[2]
Radium-226	300 pCi/m^3	10 CFR Part 20 Appendix B[2]
Radium-228	500 pCi/m^3	10 CFR Part 20 Appendix B[2]
Thorium-227	100 pCi/m^3	10 CFR Part 20 Appendix B[2]
Thorium-228	4 pCi/m^3	10 CFR Part 20 Appendix B[2]
Thorium-230	3 pCi/m^3	10 CFR Part 20 Appendix B[2]
Thorium-232	0.5 pCi/m^3	10 CFR Part 20 Appendix B[2]
Uranium-234	20 pCi/m^3	10 CFR Part 20 Appendix B[2]
Uranium-235	20 pCi/m^3	10 CFR Part 20 Appendix B[2]
Uranium-238	20 pCi/m^3	10 CFR Part 20 Appendix B[2]

[1]Original values in µCi/mL multiplied by 10^{12} to obtain units shown.
[2]OSHA uses 25% of the values found in this reference as the thresholds requiring posting of an area as an airborne radioactivity area [29 CFR 1910.1096(e)(4)(i)(b)].

4.2.4.2 Calculate Maximum COPC-to-Particulate Ratios for Each COPC

Since the objective of this analysis is to identify ambient TSP threshold concentrations that indicate potentially hazardous concentrations of one or more of the COPCs, it was necessary to establish a conservative estimate of the fraction of each COPC in airborne particulate matter. This was accomplished based on the maximum COPC concentrations shown in Tables 4-1 and 4-2; those values are summarized in the second column of Table 4-4 for the non-radioactive COPCs and in Table 4-5 for the radioactive COPCs.

- For non-radioactive COPCs, the ratio is a dimensionless number obtained by dividing the maximum value (given in mg/kg) by 10^6 to account for the difference in units. For example, dividing the maximum arsenic value of 239 mg/kg by 10^6 gives a mass fraction of 2.39 E-04.

- For radioactive COPCs, the ratio is expressed in units of picocuries of activity per microgram of material. For example, the maximum (activity) concentration of thorium-230 was 591 pCi per gram of material. Dividing that result by 10^6 gives a mass fraction of 5.91 E-04 pCi per microgram of material (i.e., 5.91 E-04 pCi/µg).

Results of these calculations are summarized in the third column of Table 4-4 for the non-radioactive COPCs and in the third column of Table 4-5 for the radioactive COPCs.

Table 4-4: Derivation of TSP Trigger Levels For Non-Radioactive COPCs

COPC	Maximum Concentration (mg/kg)	Maximum Mass Fraction[1]	Ambient Limit (µg/m³)	Unadjusted TSP Trigger Level (µg/m³)	Adjusted TSP Trigger Level (µg/m³)[2,3]
Aluminum	33,700	3.37E-02	1,000	29,674	2,967
Antimony	1.50	1.50E-06	500	333,333,333	33,333,333
Arsenic	239	2.39E-04	2	8,368	837
Barium	384	3.84E-04	500	1,302,083	130,208
Beryllium	6.41	6.41E-06	50	7,800,312	780,031
Cadmium	3.50	3.50E-06	2	571,429	57,143
Calcium	146,000	1.46E-01	2,000	13,699	1,370
Chromium	66.0	6.60E-05	10	151,515	15,152
Cobalt	23.8	2.38E-05	20	840,336	84,034
Copper	83.0	8.30E-05	1,000	12,048,193	1,204,819
Iron	65,300	6.53E-02	5,000	76,570	7,657
Lead	84.0	8.40E-05	50	595,238	59,524
Magnesium	13,900	1.39E-02	5,000	359,712	35,971
Manganese	5,190	5.19E-03	20	**3,854**	**385**
Mercury	0.17	1.70E-07	25	147,058,824	14,705,882
Molybdenum	31.9	3.19E-05	500	15,673,981	1,567,398
Nickel	44.0	4.40E-05	15	340,909	34,091
Phosphorus	1,530	1.53E-03	100	65,359	6,536
Selenium	90.0	9.00E-05	200	2,222,222	222,222
Silver	1.18	1.18E-06	10	8,474,576	847,458
Sulfate	2,655	2.66E-03	100	37,665	3,766
Thallium	2.50	2.50E-06	20	8,000,000	800,000
Uranium	482	4.82E-04	50	103,734	10,373
Vanadium	132	1.32E-04	50	378,788	37,879
Zinc	381	3.81E-04	2,000	5,249,344	524,934

[1]Units are mg of COPC per mg of material.
[2]In practice, these trigger levels include yet another level of conservatism, because the standards and guidelines used to identify ambient concentration limits for each COPC are based on 8-hour and 10-hour average ambient concentrations. In contrast, the real-time alarming function will be activated whenever the rolling one-hour TSP level reaches the minimum calculated trigger level of 385 µg/m³ (as discussed in Section 4.2.4.3).
[3]Results for COPC with lowest trigger level shown in bold red.

Table 4-5: Derivation of TSP Trigger Levels For Radioactive COPCs

COPC	Maximum Concentration (pCi/g)	Maximum Mass Fraction[1]	Ambient Limit (pCi/m^3)	Unadjusted TSP Trigger Level (µg/m^3)	Adjusted TSP Trigger Level (µg/m^3)[2,3]
Lead-210	260	2.60E-04	100	384,615	38,462
Polonium-210	320	3.20E-04	300	937,500	93,750
Radium-226	880	8.80E-04	300	340,909	34,091
Radium-228	7.66	7.66E-06	500	65,274,151	6,527,415
Thorium-227	20.9	2.09E-05	100	4,784,689	478,469
Thorium-228	13.7	1.37E-05	4	291,971	29,197
Thorium-230	591	5.91E-04	3	**5,076**	**508**
Thorium-232	10.9	1.09E-05	0.5	45,872	4,587
Uranium-234	412	4.12E-04	20	48,544	4,854
Uranium-235	18.9	1.89E-05	20	1,058,201	105,820
Uranium-238	417	4.17E-04	20	47,962	4,796

[1]Units are picocuries of COPC per microgram of material.
[2]In practice, these trigger levels include yet another level of conservatism, because the standards and guidelines used to identify ambient concentration limits for each COPC are based on 8-hour and 10-hour average ambient concentrations. In contrast, the real-time alarming function will be activated whenever the rolling one-hour TSP level reaches the minimum calculated trigger level of 385 µg/m^3 (as discussed in Section 4.2.4.3).
[3]Results for COPC with lowest trigger level shown in bold red.

4.2.4.3 Calculate TSP Trigger Levels

The maximum mass fraction for each COPC (shown in the third column in Tables 4-4 and 4-5) was divided into the COPC's ambient limit (shown in the fourth column) to calculate the TSP concentration that would indicate an airborne concentration of potential concern for that COPC. Those results are shown in the fifth column of Tables 4-4 and 4-5. Note that the derived trigger level values assume that the maximum historical COPC fractions will occur in all airborne fugitive dust generated during remediation, and that those fractions will be present throughout the site (including at the site boundary). In reality, the concentrations of COPCs in fugitive dust generated during remedial activities will be an average of levels found in contaminated soil/waste material and the much lower levels found in largely uncontaminated materials outside of the active operations.

Example trigger level calculations for non-radioactive and radioactive COPCs are shown below:

- Manganese has a maximum mass fraction of 5.19E-03 and an ACGIH TLV of 20 µg/m^3. The TSP trigger level was calculated as 20 µg/m^3 ÷ 5.19E-03, or 3,854 µg/m^3.

- Thorium-230 has a maximum mass fraction of 5.91E-04 pCi/µg and a DAC equivalent to 3 pCi/m^3. The TSP trigger level was calculated as 3 pCi/m^3 ÷ 5.91E-04 pCi/µg, or 5,076 µg/m^3.

A review of Tables 4-4 and 4-5 shows that manganese has the lowest TSP trigger level among all COPCs and that thorium-230 has the lowest TSP trigger level among radioactive COPCs. To provide an additional margin of safety, each initial trigger level calculation was subsequently divided by 10; those results are shown in the rightmost column in Tables 4-4 and 4-5. Thus, for manganese the adjusted TSP trigger level becomes 385 $\mu g/m^3$. For thorium-230, the TSP trigger level becomes 508 $\mu g/m^3$.

In practice, these trigger levels include yet another level of conservatism, because the standards and guidelines used to identify ambient concentration limits for each COPC are based on 8-hour and 10-hour average ambient concentrations. In contrast, the real-time alarming function will be activated whenever the rolling ***one-hour*** TSP level reaches the calculated trigger level which, based on the COPC analysis presented above, would be 385 $\mu g/m^3$ – a fairly high TSP concentration.

The trigger level analysis and derivation presented above incorporate a number of conservative assumptions consistent with a health protective approach, including:

1. The use of all summarized COPC soil/waste concentration data found in the RI. This included data from all surface and subsurface sampling areas (including historical mining areas, “background” areas and haul roads);
2. Trigger levels were calculated for all sampled radioactive and non-radioactive COPCs having a regulatory workplace exposure limit (as shown in Table 4-3);
3. Each trigger level was calculated based on the ***maximum*** COPC concentration among the different sample areas and types (including both grab and composite samples) – and not the average or mean concentration. This was true even if the maximum COPC concentration from a given area was an apparent “outlier” from a single grab sample;
4. The initial trigger level calculation for each COPC was reduced by a factor of 10 to provide an additional safety factor;
5. The lowest calculated trigger level among the results presented in Tables 4-4 and 4-5 (385 $\mu g/m^3$ for manganese and 508 $\mu g/m^3$ for thorium-230) was used as the operational TSP trigger level based on analysis of soil and waste material level;
6. The operational TSP trigger level was further reduced to 260 $\mu g/m^3$ based on the historical TSP standard that was in effect from 1971 to 1987 – constituting an additional 32.5% reduction from the value obtained by trigger level analysis;
7. The TSP trigger level alarm will be activated whenever the ***one-hour*** rolling TSP ambient concentration exceeds 260 $\mu g/m^3$. By contrast, the regulatory health-based workplace exposure limits incorporated into the trigger level derivations are based on ***eight-hour*** and ***ten-hour*** average concentrations;
8. Finally, a separate Health and Safety Program presented in Appendix L of (MWH 2013) will protect workers by minimizing exposure to airborne dust and by collecting personnel samples to verify their exposure to airborne COPCs. Please

refer to the Remedial Action Health and Safety Plan in Appendix L of the BODR for additional details.

Several airborne particulate standards have been enacted since the early 1970s. They are summarized on pages 3090-3091 of *Federal Register* Vol. 78 No. 10, dated January 15, 2013.

- In 1971 the EPA established a National Ambient Air Quality Standard (NAAQS) for TSP including 1) a primary 24-hour average of 260 $\mu g/m^3$ not to be exceeded more than once per year and 2) an annual geometric mean of 75 $\mu g/m^3$. The proposed Midnite Mine air monitoring program is based on TSP measurements because the objective is to measure ***all*** airborne fugitive dust material, and not just the smaller particles addressed by the subsequent NAAQS listed below. Also, the regulatory workplace standards used to develop the DCAQMP trigger levels are based on ***total*** airborne COPC concentrations, and not the smaller particles.
- In 1987 the NAAQS for TSP was replaced with an NAAQS for particulate smaller than 10 microns in diameter, or PM_{10}. The PM_{10} NAAQS included a 24-hour average of 150 $\mu g/m^3$ and an annual average of 50 $\mu g/m^3$.
- In 1997 two standards regulating particulates smaller than 2.5 microns in diameter ($PM_{2.5}$) were enacted, including a 24-hour standard of 65 $\mu g/m^3$ and an annual standard of 15 $\mu g/m^3$.
- In 2006 the annual PM_{10} standard was rescinded, and the annual $PM_{2.5}$ standard was reduced from 65 $\mu g/m^3$ to 35 $\mu g/m^3$.
- Note that there are subtle differences in the statistical forms of the $PM_{2.5}$ and PM_{10} standards listed above; the intent of this summary is to illustrate the progression of airborne particulate standards toward increasingly smaller particles.

Based on the preceding analyses, a TSP trigger level of 260 $\mu g/m^3$ is proposed for the Midnite Mine real-time monitoring network. Use of that limit in the dust control program will ensure that:

1. Airborne concentrations of all non-radioactive COPCs are kept below 10% of the lowest standards or guidelines specified by OSHA PELs, CAL/OSHA PELs, NIOSH RELs, and/or ACGIH TLVs;
2. Airborne concentrations of all radioactive COPCs are kept below 10% of the applicable DACs, which is considered a health protective measure because it is less than the 25% DAC level requiring posting as an airborne radioactivity area under OSHA [29 CFR 1910.1096(e)(4)(i)(b)]; and
3. Airborne TSP concentrations are kept below historical standards.

4.3 Air Quality Oversight

Remedial activities at the site will be conducted by the Construction Contractor as shown in Figure 1-1. Air quality oversight will be provided by the Field Engineer, an employee of the Construction Manager who is hired by the Companies independent from the Construction Contractor. The Field Engineer performs routine TSP monitoring as described in this section, and also performs the regulatory air monitoring described in Section 5.0 of this document. The Field Engineer notifies the Construction Contractor whenever additional actions are required to address any dust problems, based on real-time monitoring data and visual observation of dust-generating activities. Note that the Construction Manager also provides oversight of the Construction Contractor for remedial activities in general, and not just those aspects related to air quality. The Supervising Contractor will notify the EPA and Tribe within 24 hours of any actionable TSP trigger level and the actions used to reduce the dust level.

Additionally, an Air Quality Assurance Contractor (AQAC) hired by the Companies will install the real-time monitoring equipment, manage the collected air monitoring data, perform calibrations and repairs, and prepare quarterly air quality monitoring reports. The AQAC will also train the Field Engineer in the operation of the real-time monitoring network and be available for consultation as required.

4.4 Rationale for Use of TSP Measurements

As will be discussed in Section 4.5 of this document, real-time monitors will be configured for TSP for this project rather than PM_{10} or $PM_{2.5}$ (fine particulate). While contemporary ambient particulate monitoring commonly focuses on PM_{10} (and increasingly $PM_{2.5}$) because those particles are more easily retained in the lungs after inhalation, TSP monitoring is appropriate for this project because:

- The construction dust at the Midnite Mine site is likely to be coarser than the PM_{10} particulate size. In general, smaller particle sizes require lower shear or wind velocities to move them. However, this relationship reverses for particle sizes less than 0.2 mm (Kirkby and Morgan 1980). For undisturbed ground, the PM_{10} sized particles, which are less than 0.01 mm in size, are likely to be relatively stable compared to larger sand and silt sized particles. The $PM_{2.5}$ sized particles are the clay-sized fraction of the soil and are even more stable. Although disturbance may change this dynamic somewhat, most particulate emissions resulting from excavation and hauling will be larger than PM_{10} and would not be measured by a PM_{10} or $PM_{2.5}$ sampler.

- Because PM_{10} and $PM_{2.5}$ are ***subsets*** of TSP, a sampler that is set to monitor TSP will also capture the PM_{10} and $PM_{2.5}$ materials. However, a sampler set to monitor PM_{10} and $PM_{2.5}$ particle sizes would fail to detect much of the larger particulate.

- TSP monitoring is more useful for evaluating the effectiveness of site dust control efforts and will be protective of public health as well.
- TSP monitoring is more useful for evaluating the potential for spread of airborne dust from the site and will indicate the total amount of airborne COPCs which could be deposited off-site and not (only) some fraction of the dust.

4.5 Design and Implementation of Real-Time Monitoring Network

Appendix B to this document, *Standard Operating Procedure and Quality Assurance Plan: Midnite Mine Real-Time Monitoring and TSP Alarming System,* describes in detail the operation and maintenance of the real-time monitoring network described below. Areas addressed include:

1. Configuration and installation of the monitors;
2. Calibration and quality assurance requirements;
3. Establishing a TSP concentration correction factor;
4. Preventive maintenance;
5. Routine operation procedures;
6. Alarm calculation / notification procedures;
7. Troubleshooting; and
8. Meteorological station operations.

4.5.1 Real-Time Particulate Monitoring

A network of real-time total suspended particulate (TSP) air monitors, situated at appropriate locations around the Midnite Mine, will be designed, installed and operated as part of this plan. A fleet of at least six portable, real-time particulate samplers (E-Samplers manufactured by Met One Instruments, Inc. of Grants Pass, Oregon) will be included in this network at any given time. Three semi-permanent samplers will be located adjacent to the Mine Fence (see Figure 4-3) to detect potential off-site migration of dust emissions. A minimum of three samplers will be sited with the objective of monitoring particulate concentrations in ambient air both upwind and downwind of remediation activities on any given day, recognizing that the on-site work will vary in location over time.

The prevailing winds at the site have strong southwest and northeast components, as shown in the wind rose in Figure 4-2. The southwest winds tend to be stronger, while the northeast winds are often light. The high frequency of light northeast winds may reflect a topographically-driven drainage flow. It is suspected that the stronger southwest winds dominate during daytime hours, while the light northeast winds are prevalent at night.

Three semi-permanent monitors will be placed along the boundaries of the Midnite Mine and at least three monitors will be designated as roving units. A map of the tentative placement of the permanent monitors and meteorological station is shown in Figure 4-3 below. The monitors would be placed as follows:

- One semi-permanent site (ES-3) will be placed near the southwest boundary of the site and will generally be upwind during stronger southwest wind conditions.

- One semi-permanent site (ES-1) will be placed near the northern boundary of the site to monitor emissions leaving the site in the prevailing wind direction.

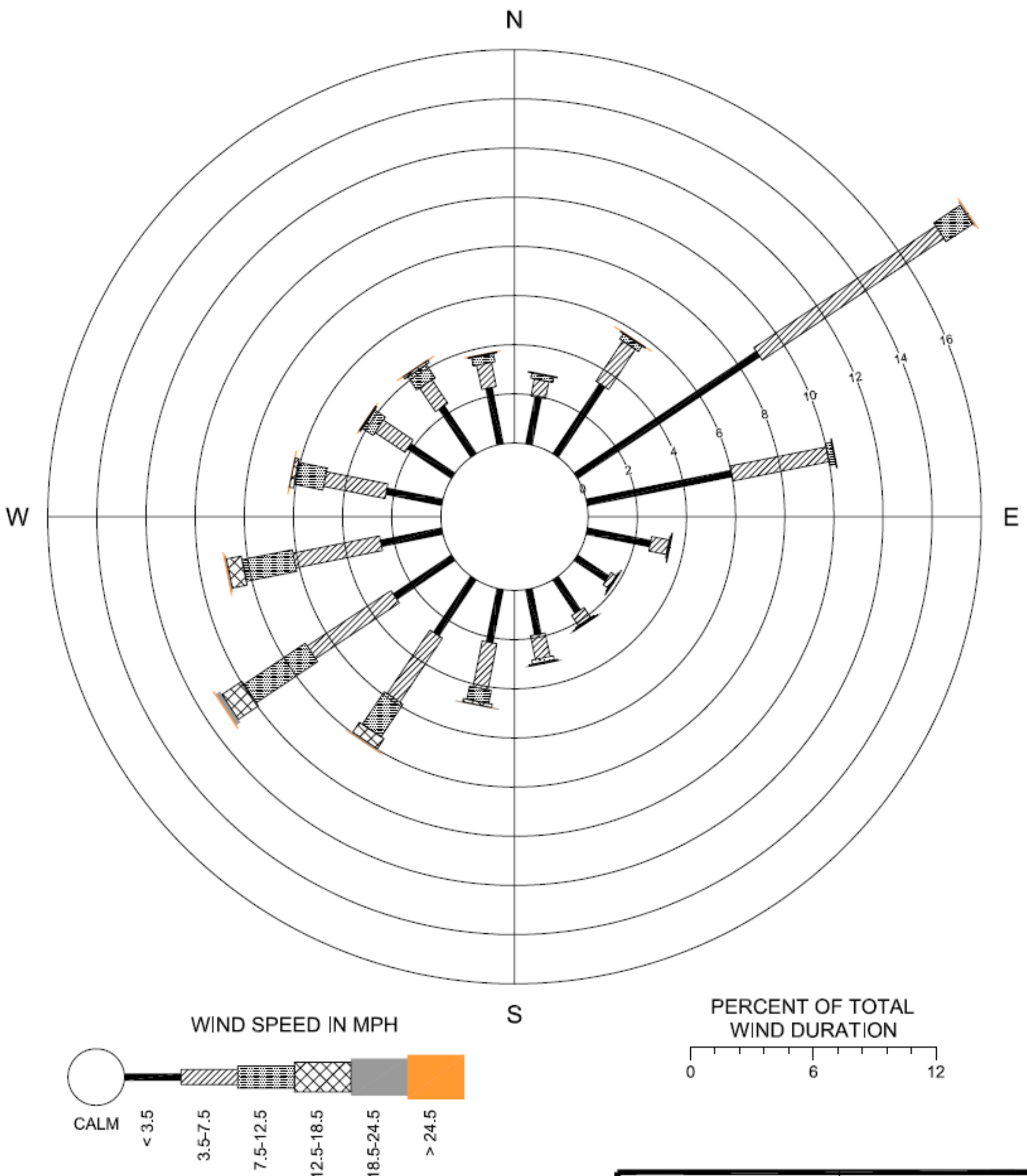
- One semi-permanent site (ES-2) will be placed near the center on the eastern boundary of the site; it will also monitor emissions leaving the site during prevailing wind conditions.

- At any given time, it is highly probable that at least one of these permanent sites will be upwind from site activities and at least one will be downwind.

- At least three roving samplers will be placed adjacent to, and downwind of, active remediation work sites within the boundaries of the remedial activities at Midnite Mine. Exact locations will be identified by monitoring personnel, and will be selected based on projected activities for each work day as identified by the Construction Manager and Construction Contractor. Selection considerations will include planned construction activities, wind patterns, ease of access, availability of radio communication with the base station, and protection of samplers from inadvertent damage. These monitors will need to be moved regularly (in some cases on a daily basis) as remediation progresses. Relocation of samplers will be documented, including the rationale for each move. The location of the roving monitors and rationale for their location will be provided in the Monthly Report.

- Because the objective of the roving samplers is to monitor maximum airborne particulate concentrations resulting from remediation activities, they will generally be placed in close proximity (e.g. 50-100 yards) in downwind directions from the most significant construction areas, subject to logistical constraints noted above. As shown in Figure 4-2 and indicated by local topography, daytime winds at the Midnite Mine site should be predominantly from the southwest. Therefore, roving samplers will ***generally*** be located within 100 yards to the northeast of each significant construction area. However, the Construction Manager's Field Engineer will monitor readings from the on-site meteorological station on a daily basis to ensure that the monitors are appropriately sited during atypical weather conditions.

Figure 4-2: Wind Rose For Midnite Mine Superfund Site

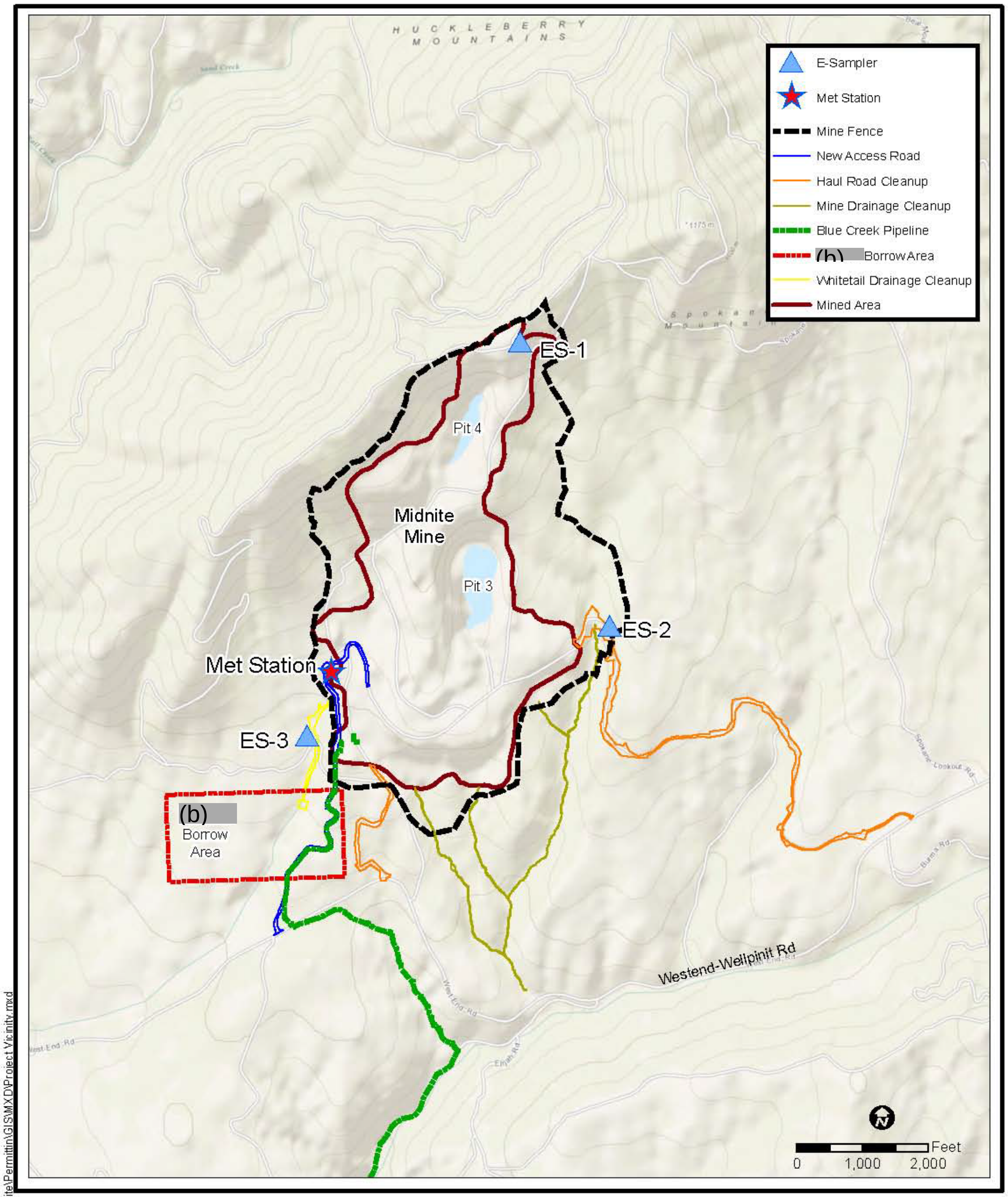


NOTES:

1. WIND SPEED IN MPH
2. PERCENT OF TOTAL WIND DURATION
3. DATA COLLECTED FROM 1991 TO 1998
4. SOURCE: SHEPHERD MILLER, INC.
5. SPOKES INDICATE WHICH DIRECTION THE WIND IS BLOWING FROM

M4001036

Midnite Mine RI/FS Final RI Report	EPA REGION 10	
Midnite Mine Wind Rose		
FILE/DRAWING NO.	DATE: Sept. 2005	Figure 2-4
DOCUMENT CONTROL NO.	DSGN.	CHK.



WORTHINGTON MILLER ENVIRONMENTAL, LLC.	**Figure 4-3** **Fixed Air Samplers and Meteorological Station**	Date: November 2015 Project: Midnite Mine File: Project Geology.MXD

Z:\Project Files\Midnite\Permittin\GIS\MXD\Project Vicinity.mxd

4.5.2 Real-Time Meteorological Monitoring

A meteorological monitoring station will be sited within the Mine Fence of the Midnite Mine Site, in a location exposed to the prevailing winds (see Figure 4-3). The meteorological station will be utilized to monitor wind conditions which will help pinpoint sources of particulate emissions and to document weather conditions during dust events.

The meteorological tower will be a 10-foot tall portable tripod equipped with a Campbell Scientific Model CR1000 datalogger with an internal data storage capacity of over six months of hourly meteorological data plus internet communication capabilities. The tower installation will be sufficiently sturdy to withstand weather extremes, yet can be easily relocated if circumstances require it. The station will include high-quality Met One, Inc. sensors for the following parameters, as documented in Section B.9 of Appendix B:

- Wind Speed,
- Wind Direction,
- Temperature,
- Precipitation,
- Relative Humidity,
- Solar Radiation,
- Other useful parameters agreed upon by EPA and the Companies.

4.5.3 Networking and Data Accessibility of the Monitoring System

The particulate monitors and the meteorological station will feature full remote communications, allowing real-time networking of the complete system. The system will publish real-time data to an internet website. The website will show the current rolling one-hour and block one-hour TSP concentration averages. For comparison the website will also indicate the actionable TSP trigger level of 260 $\mu g/m^3$. This will allow stakeholders to view real-time particulate and meteorological data with no special software required by the end-user. Password-restricted site access will be employed for more technical needs such as making modifications to the data monitoring programs.

4.5.4 Real-Time Alarm When Trigger Levels are Exceeded

The network of samplers will be programmed to alarm when the pre-set TSP trigger level (a one-hour rolling average of 260 $\mu g/m^3$) is recorded by one or more of the E-Samplers. This alarm will be broadcast to the Construction Manager’s Field Engineer and other designated personnel via e-mail or telephone, allowing immediate response and investigation by personnel on-site. The internet page will show which monitor has been triggered and the prevailing wind conditions, helping point to the source of excess emissions. The procedure used to calculate ambient TSP concentrations and determine the presence of an alarm condition is described in Section B.7 of Appendix B.

Required responses to alarm notifications will vary, depending on the cause of the high TSP concentrations. The general sequence to alarm notifications will be as follows:

1. First, confirm that the elevated TSP readings are not being caused by fog or heavy, wet snow. Both conditions can cause elevated readings because the E-Samplers are fundamentally visibility monitors. If the high readings are caused by those conditions, the episode should be documented but additional dust control measures would generally not be warranted.

2. Review the current TSP readings from all samplers, as well as the meteorological data (particularly wind speed and wind direction). Based on those readings, determine whether 1) the sampler reporting an alarm is immediately downwind from any construction activity, and 2) if the alarming sampler is reading significantly higher than the other samplers. If the answer to both is yes, then the construction activity is likely the source of the emissions and additional dust control measures should be implemented.

3. If a single sampler is alarming, but readings from all other samplers (including those in upwind locations) are of similar magnitude, it is likely that a regional dust event is occurring. Likely causes would include wildfire smoke or (less commonly) airborne particulate from agricultural activities such as plowing or burning of fields. In such cases, the construction activity occurring upwind from the sampler is probably not the source of the emissions and additional dust control measures are not warranted.

4. If samplers on the downwind side of the site are alarming, but upwind samplers are not, it is likely that the elevated particulate levels are being caused by high winds. As an example, at the FMC site in Pocatello, sustained winds of 20 mph or greater have generally resulted in high TSP readings site-wide, unless the ground surface was wet from recent precipitation. This situation is the most problematic for construction activities because additional dust control (such as watering of specific areas) may not sufficiently reduce overall TSP levels on the site. In extreme cases, temporary cessation of construction activities may be necessary, not because stopping work will bring TSP concentrations below the trigger level, but for the sake of protecting on-site workers from potentially hazardous COPC concentrations.

5. Regardless of cause, all reported TSP alarm conditions must be documented as shown in Figure B.7-1 of Appendix B. A clean copy of that form is provided at the end of Appendix B. Items to be reported will include:

    - Date and time of alarm notification.
    - Sampler ID, location, and TSP reading.
    - Meteorological conditions, including:
        - Wind speed,
        - Wind direction,
        - Daily precipitation total at time of alarm,
        - Presence / absence of precipitation or fog.

- Probable cause of alarm condition (as described above), and actions taken in response. If no action was taken, justify why no action was necessary.
- Include photographs as necessary to support response decisions. For example, if the high TSP readings were caused by wildfire smoke, a photograph will help document that fact.

4.6 Rationale for Use of Met One E-Samplers

The E-Samplers are rugged, portable, durable real-time particulate monitors, made specifically for long-term unattended operations outdoors. Details and specifications for the E-Sampler can be found at:

http://www.metone.com/documents/E-SAMPLER_Brochure.pdf

Figure 4-4: Photos of Met One E-Sampler

The primary advantages of the E-Sampler include:

- The sampler can be operated unattended for extended periods – unlike other samplers requiring frequent attention.
- The sampler includes a weatherproof enclosure and is deployed on a portable tripod.
- The sampler can be operated from either AC or solar power.
- Measurement range is 0.001 mg/m^3 (1 $\mu g/m^3$) to 65 mg/m^3 (65,000 $\mu g/m^3$).
- The sampler includes both analog and RS-232 output options and supports radio and modem communication.
- Can be operated with averaging periods from 1 to 60 minutes.
- Unit weighs only 28 pounds and can be easily moved by one person.
- Bison Engineering has successfully employed these samplers in conjunction with remediation and construction activities at the FMC OU in Pocatello, Idaho.

The E-Samplers offer advantages from a logistical standpoint, including lower required and expected downtime, cost, ease of use, portability and dependability. An E-Sampler can easily be shut down, relocated, and restarted by a single minimally-trained field operator in 30 minutes or less with no special equipment. Otherwise, there is essentially no sampler downtime beyond routine quality assurance activities such as flow checks/calibrations, leak checks and audits. These activities are generally less time-intensive for E-Samplers than for other particulate monitors.

By contrast, other continuous particulate monitors (such as the EPA Reference Method Thermo Environmental TEOM and Met One BAM-1020 samplers) are considerably larger and more complex, and must be housed inside a substantial climate-controlled shelter that requires AC power. Relocation of such units in response to changing construction operations and wind conditions is a substantial task, and considerable training is required to achieve proficiency in their operation. If problems arise, troubleshooting can be difficult and replacement parts are not always immediately available. That issue will not be a concern for the E-Sampler network because the Companies propose to purchase eight units, with a maximum of six in use at any given time. In the event that an E-Sampler fails, it will immediately be replaced with an identical unit so that sampling can continue uninterrupted. The problematic unit then will be returned to the manufacturer for repair.

4.7 Real-Time Air Monitoring Schedule

Real-time air monitoring will be performed on the site per this plan any time that remediation construction activities described in this plan are being carried out on the site. During any extended shutdown periods (e.g., due to heavy winter snowfall or seasonal shutdowns) real-time monitoring would not be performed. Section B.6 of Appendix B describes routine operational procedures for the E-Sampler monitoring network.

During active construction, real-time air monitoring will be performed during periods when the remedial action construction activities described in this plan are being performed at the site. Depending on snowfall the construction season may be year-round, or shut down for several months over the winter. For example, if the operating shift is 10 hours per day, 6 days per week, the real-time monitoring will be performed during the operational hours only. Effectiveness of wetting and water application procedures will be evaluated by the presence or absence of visible dust, as measured by Methods 9 and/or 22 as applicable. If visible dust is present even after enhanced control measures have been implemented, the Companies will implement continuous (i.e., 24 hours a day, 7 days a week) monitoring downwind of areas of disturbed or exposed soils and continue with water application procedures until visible dust is eliminated.

4.8 Quality Assurance

Quality assurance is critical to the collection of reliable, high-quality data that can be used to support operational decisions during remediation. Section B.3 of Appendix B describes quality assurance aspects of the E-Sampler monitoring network, while Section B.4 documents the procedure that will be used to calibrate the samplers' responses to ambient TSP concentrations. Proposed quality assurance of this monitoring system will include:

- Calibration of the meteorological system and each E-Sampler at the time of installation using NIST-traceable calibration standards.
- Monthly checks of the E-Samplers' flow rates and indicated temperature and pressure readings by the operator stationed on-site.
- Quarterly inspections/audits of monitoring equipment using separate equipment from that used by the site operator.
- Quarterly maintenance and calibration of equipment in accordance with the manufacturers' recommendations.
- Frequent remote monitoring of the meteorological system and E-Sampler readings by experienced personnel (including both the Field Engineer and the AQAC), so that developing problems can be quickly detected and corrected.

4.9 Data Reporting

As discussed in section 4.5.3, real-time monitoring data will be available to all stakeholders via an internet web page. In addition, the Midnite Mine RD/RA monthly report will include a listing of periods when the TSP trigger level was exceeded and periods of E-Sampler downtime (i.e., when any given E-Sampler should have been collecting data, but was not operating due to equipment failure or other factors). It will also indicate whether each alarm period was caused by site remediation activities or by off-site factors (such as wildfire smoke or intensive agricultural activities). The report will document the actions that were requested of the Construction Contractor, specific actions that were taken, and the effectiveness of those actions in reducing ambient TSP concentrations to acceptable levels. In cases where false TSP alarms were reported due to adverse weather conditions (such as dense fog or heavy snow) and no action was warranted, those conditions will be documented.

Also, a compiled quarterly monitoring report will be submitted within 45 days after the end of each calendar quarter. These reports will include:

- Hourly particulate readings for each E-Sampler monitoring location.
- Hourly readings for each meteorological instrument, including wind speed, wind direction, wind direction standard deviation, temperature, relative humidity and precipitation.
- Monthly and quarterly wind roses for the meteorological site.
- A cumulative listing of periods when particulate levels were exceeded and periods of E-Sampler downtime (i.e., when any given E-Sampler should have been collecting data, but was not operating due to equipment failure or other factors).
- Monthly flow, temperature and pressure checks conducted on the E-Samplers.
- Equipment calibrations and audits performed during the quarter.
- A compilation of all TSP alarm conditions that occurred during the quarter, including:
    - The average and maximum TSP concentration during each episode;
    - An evaluation of whether each alarm condition was caused by construction activities, adverse weather conditions or a combination of both;
    - Actions taken in response to each valid alarm condition, and the resulting change in ambient TSP concentrations at the E-Sampler(s) in question.
- A summary of any lessons learned from that quarter's TSP alarm episodes (i.e. changes in construction-related operations or procedures that would prevent similar events from recurring).

5.0 REGULATORY MONITORING

Section 4.0 described the network of real-time air monitors that, in combination with the dust control measures presented in Section 3.0, will be used to maintain airborne COPC concentrations below potentially hazardous levels, using airborne TSP concentration as a surrogate measurement (see Section 4.2). The system will provide automated alarm notifications to site personnel whenever TSP concentrations exceed the trigger level (260 $\mu g/m^3$), which will lead to increased dust control measures and – in extreme cases – temporary cessation of construction activities. The real-time monitoring network is not required by regulation but is designed to provide an added measure of protection.

The primary objective of the regulatory monitoring program is to ensure compliance with the FARR, Tribal NSR, and SQCS General Air Permit. These rules require periodic emissions testing and visible emissions monitoring using one of two visual observation methods, depending on source type:

- EPA Method 9 is used to monitor visible emissions from stationary sources, which must not exceed 20 percent opacity averaged over six consecutive minutes.

- EPA Method 22 is used to monitor fugitive emissions from non-point sources, such as material transfer points and process equipment.

The rules for limiting visible emissions (40 CFR §49.124) and rules for limiting fugitive PM emissions (40 CFR §49.126) require the monitoring for visible emissions from stationary sources and monitoring fugitive PM. The SQCS General Permit also requires monitoring for fugitive dust, visible emissions, and compression ignition engine emissions. EPA Method 9 will be used to monitor visible emissions from stationary emission sources with exhaust stacks and EPA Method 22 will be used to monitor the presence of fugitive particulate emissions (e.g., road dust). The regulatory limit for visible emissions from stationary sources is 20 percent opacity averaged over six consecutive minutes (40 CFR §49.124). The SQCS General Permit also requires the monitoring of visible and fugitive emissions with specific limitations and requirements. The regulatory requirements for limiting fugitive PM emissions are to implement all reasonable precautions to prevent fugitive PM emissions and to maintain and operate identified sources with minimal fugitive PM emissions (FARR - 40 CFR 49.126). The substantive limits set by the SQCS General Permit are 12 percent opacity for crushers and 7 percent opacity at other affected emissions units. Forest harvest activities and emissions from fuel combustion in mobile sources are exempt from these fugitive dust monitoring requirements.

It is anticipated that emissions from all stationary engines would not exceed the Tribal New Source Review and Title V major source thresholds as described in the Air Emissions Inventory and Regulatory Analysis (WME 2015). Consistent with EPA's guidance, for every consecutive 12-month period (commencing after start-up of the stationary sources), the source will maintain adequate records to demonstrate that actual emissions are kept below 50 percent of the Major Source Threshold for nitrogen oxides (NOx). If calculations indicate actual emissions at or greater than 50 percent of the Major

Source Threshold for NOx, the source will limit run-time of the various equipment to prevent NOx emissions from exceeding 100 tons per year (TPY).

In addition to the opacity monitoring discussed above, initial engine performance tests will be conducted within 60 days of achieving maximum production rate for the rock crushers, but no less than 180 days after initial operation to verify compliance with CO limits depending upon the engine tier or date the engine commenced construction as described in the SQCS General Permit. It is anticipated that all stationary compression ignition engines used on-site will be less than 300 horse power (hp) with the exception of the WTP emergency generator. Emission standards and limitations for the compression engine emissions are as follows:

- Comply with the applicable requirements of 40 CFR §63.6580 *et seq.* for National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines (40 CFR).
    - o If the stationary engines were manufactured prior to June 12, 2006, the non-emergency, non-black start CI stationary RICE ≤ 300 hp would:
        - ▪ Change oil and filter every 1,000 hours of operation or annually, whichever comes first;
        - ▪ Inspect air cleaner every 1,000 hours of operation or annually, whichever comes first, and replace as necessary;
        - ▪ Inspect all hoses and belts every 500 hours of operation or annually, whichever comes first, and replace as necessary.
    - o If any stationary compression engine is greater than 300 hp and manufactured prior to June 12, 2006, additional requirements would apply (Table 2d to Subpart ZZZZ of Part 63 and the SQCS General Permit). For compression ignition engines greater than 500 hp: limit CO to 23 parts per million, volumetric dry (ppmvd) @ 15% O_2 or reduce CO emissions by 70 percent or more. Emissions shall be controlled through the use of an oxidation catalyst. Engines rated at less than or equal to 560 kilowatt (kW) that are certified to Tier 3 standards in 40 CFR 89.112 are exempt from this limit. Engines rated at greater than 560 kW that are certified to Tier 2 standards in 40 CFR 89.122 are exempt from this limit.

Supervisory personnel will be trained and certified to use EPA Method 9 and Method 22 to monitor visible and fugitive dust emissions, and will have authority to stop or modify activity as necessary to control dust. Method 9 and Method 22 testing will be performed at each applicable emission point or source under typical conditions within 30 days of the start of operations, and annually thereafter. Engine emissions testing will be conducted by a certified technician, if necessary, using test methods from 40 CFR Part 60, Appendix A, or portable analyzers allowed by 40 CFR Part 63, Subpart ZZZZ, unless alternative methods are approved by EPA in writing in advance of the test.

The EPA Method 9 and Method 22 emission monitoring procedures are described below.

5.1 EPA Method 9

Visible emissions from stationary sources with exhaust stacks will be limited through reasonable control measures described in Section 2.0. Stationary sources are emissions from equipment that is at one location for greater than 12 months. As required by the rules for limiting visible emissions (40 CFR § 49.126), visible emissions will be monitored on an annual basis, beginning 30 days from the commencement of construction or demolition activity and when new operations begin. The substantive requirements of the SQCS General Permit require monitoring of visible emissions on a weekly basis for a 30-minute duration for the rock crushing and screening operation. EPA Method 9 - Visual Determination of the Opacity of Emissions From Stationary Sources (40 CFR Part 60, Appendix A-4) will be used to determine the opacity from each stationary source, which is further described in the Visible Emissions Field Manual, EPA Methods 9 and 22 (ETA and Entrophy 1993), provided in Appendix B. The opacity monitoring will be conducted by staff who are trained and certified in EPA Method 9 and recertified every six months. The monitoring for visible emissions from stationary sources will only occur on-site, since emissions from mobile sources are exempt and no stationary sources will be located off-site. Exhaust emissions from mobile sources and forestry activities are also exempt from these monitoring requirements. The general locations of the stationary emission sources are provided in Figure 5-1 and a general preliminary schedule of their use is provided in Table 5-1. Specific locations and schedules may vary due to specific operational needs.

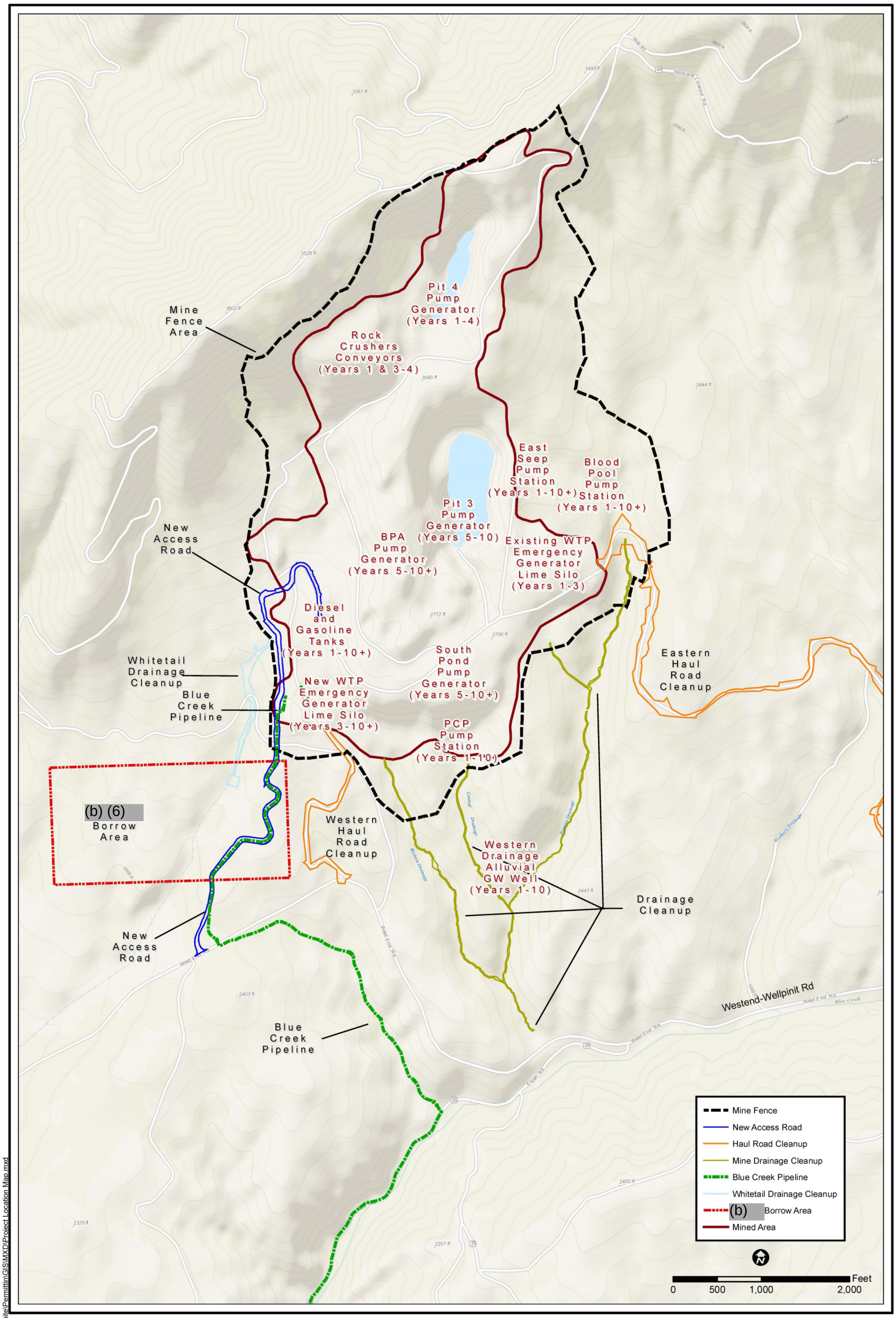
Monitoring will occur during typical operating conditions and under typical weather conditions. This excludes start-up, malfunctions, and shut-down from monitoring. Plume opacity is the degree to which the transmission of light is reduced or the degree to which the visibility of a background as viewed through the diameter of a plume is reduced. Using a stopwatch, a total of 24 observations will be recorded at each emission source every 15 seconds for a total of six minutes and recorded on the Method 9 data sheet included in Appendix C. The substantive requirements of the SQCS General Permit require a minimum of five 6-minute averages be surveyed for a minimum of 30 minutes. Observations will not begin until all factors conform to the regulations such as ambient lighting, which may include returning at a different time of day to get all of the observations under acceptable conditions.

Field records will be documented as described in EPA Method 9 and recorded on the form included in the methodology. If the plume opacity exceeds 20 percent, the cause of the visible plume will be investigated and resolved promptly within 24 hours to ensure that typical operating exhaust plumes fall below opacity requirements. Substantive requirements of the SQCS General Permit for the rock crushing and screening operation are 12 percent for the rock crusher and 7 percent for other affected units. Truck dumping into any screening operation, feed hopper, or crusher is exempt from these opacity limitations.

Table 5-1: Preliminary Schedule for Stationary Emission Sources

Stationary Equipment	Years Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Downhill Conveyor Units	X		X	X						
Radial Conveyor Units (50 hp diesel each, up to five)	X		X	X						
Primary Jaw Crusher	X		X	X						
Secondary Cone Crusher	X		X	X						
Primary Screening (Grizzly)	X		X	X						
Secondary Screening, performed as a single unit with secondary crusher	X		X	X						
Tertiary Screening	X		X	X						
Pit 4 Pump Generator	X	X	X	X						
Pit 3 Pump Generator					X	X	X	X	X	X
BPA Pump Generator					X	X	X	X	X	X
South Pond Pump Generator					X	X	X	X	X	X
East Seep Pump Station	X	X	X	X	X	X	X	X	X	X
Blood Pool Pump Station	X	X	X	X	X	X	X	X	X	X
PCP Pump Station	X	X	X	X	X	X	X	X	X	X
Western Drainage Alluvial GW Wells	X	X	X	X	X	X	X	X	X	X
WTP Emergency Generator	X	X	X	X	X	X	X	X	X	X
Diesel Tanks	X	X	X	X	X	X	X	X	X	X
Gasoline Tanks	X	X	X	X	X	X	X	X	X	X
Lime Silo	X	X	X	X	X	X	X	X	X	X

Note: Year 10 operations of emission sources are assumed to continue for the life of Water Treatment Plant activity.



WORTHINGTON MILLER ENVIRONMENTAL, LLC.

Figure 5-1
Midnite Mine Stationary Emission Sources

Date: January 2016
Project: Midnite Mine
File: MMEmissions.MXD

5.2 EPA Method 22

Fugitive emissions will be limited through reasonable control measures described in Section 2.0. Fugitive emissions include emissions that escape capture by processing equipment exhaust hoods, are emitted during material transfer, are emitted from buildings housing material processing or handling equipment, are emitted directly from process equipment, or road dust. As required by the rules for limiting fugitive PM emissions (40 CFR §49.126), fugitive PM emissions will be monitored to determine if they are present using EPA Method 22 - Visual Determination of Fugitive Emissions From Material Sources and Smoke Emissions From Flares (40 CFR Part 60, Appendix A-7). EPA Method 22 is further described in Visible Emissions Field Manual, EPA Methods 9 and 22 (ETA and Entrophy 1993), provided in Appendix B. Although Method 22 does not require specific training certification, staff responsible for conducting Method 22 monitoring will be certified in the more rigorous EPA Method 9. Fugitive dust monitoring will occur on an annual basis beginning 30 days from the commencement of construction, and will include both active construction areas and inactive areas (40 CFR §49.126). This covers on-site locations, including the Mined Area, Haul Road cleanup, Drainage cleanup, and the Blue Creek Pipeline. The SQCS General Permit requires that fugitive emission sources from the rock crushing and screening activities be surveyed using Method 22 on a weekly basis based on an average of at least five 6-minute averages. The forestry activities that will occur both on-site and off-site are excluded from this monitoring. The monitoring of inactive areas will confirm that soil has been stabilized and is no longer producing fugitive PM emissions. The monitoring will occur annually during typical weather and work conditions. A map showing an overview of the grading activity is shown in Figure 5-2 with a tentative schedule provided in Table 5-2. The specific location and schedule may vary due to specific construction operations.

Method 22 determines the amount of time that visible emissions occur during the observation period and does not require a determination of opacity. The observation location will be selected based on the source of the activity and will be between 15 feet and 0.25 mile from the fugitive emission source. The observer will be in a position to observe any potential emissions without sunlight shining directly in the observer's eyes. Method 22 will be used only to determine the presence or absence of fugitive emissions and not the opacity value. Using two stopwatches, the overall observation period will be recorded and the second stopwatch will be used to record the duration of visible emissions during that period.

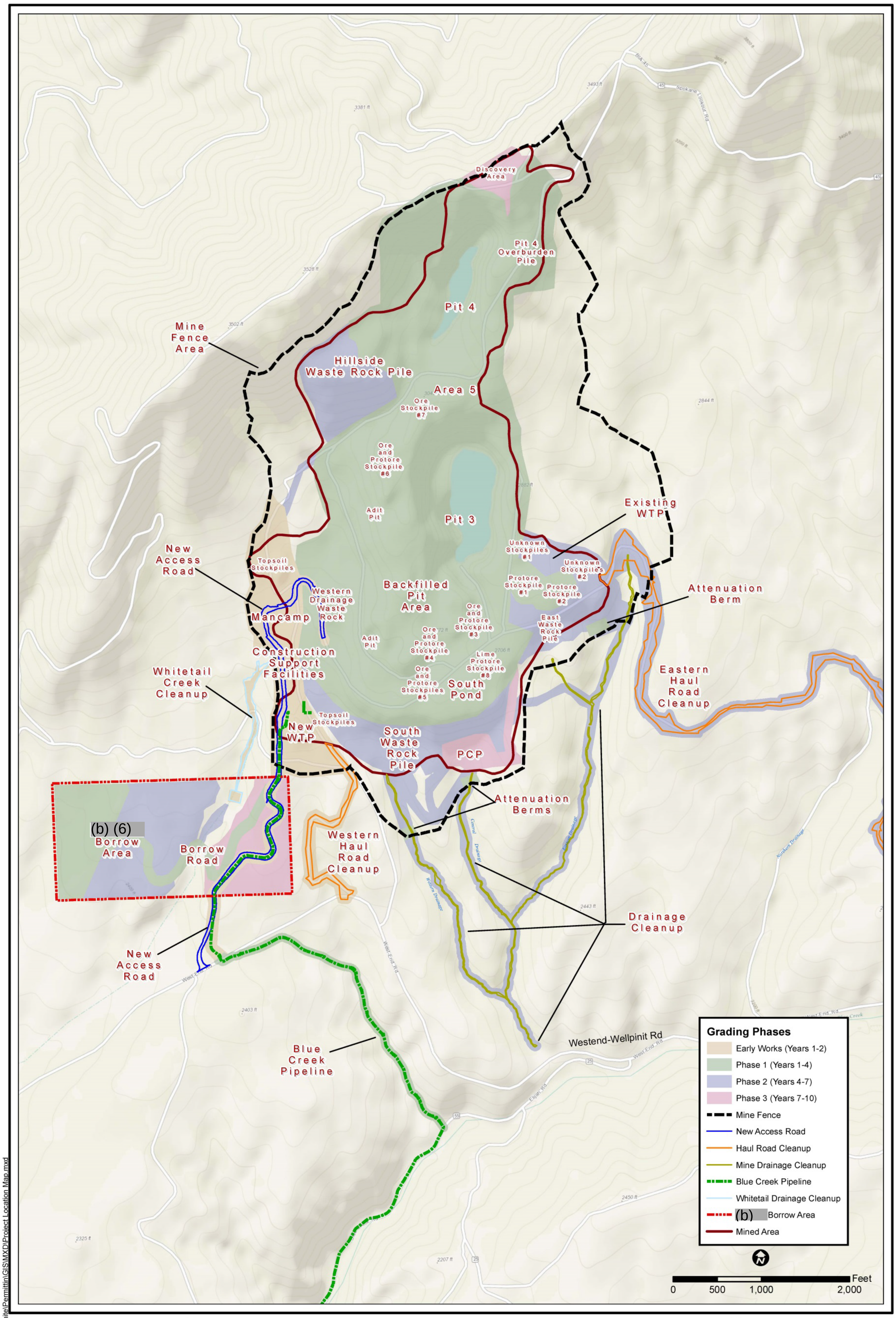
Method 22 does not include a specific duration for the monitoring, but should be long enough to capture the full breadth of typical activity at each location. The typical observation period is 15 minutes to one hour and no less than six minutes. Continuous observations should be no longer than 15 to 20 minutes. Emission frequency and the overall observation period will be recorded on the Method 22 form in Appendix D. If fugitive emissions are identified, the cause will be investigated and reasonable precautions and procedures will be taken to minimize the fugitive PM emissions. As required, the DCAQMP will be updated to identify the reasonable precautions and procedures taken to minimize fugitive PM emissions.

Table 5-2. Tentative Grading Activity Schedule

Activities	Locations	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Topsoil Stockpile Excavation	Topsoil Stockpiles	X																			
Prepare Construction Support Zone	Construction Support Zone	X																			
Construct Site Access	Site Access	X																			
Remove Western Haul Road	West Access Road	X																			
Cleanup Whitetail Creek	Whitetail Creek	X																			
Construct Decontamination Zone	Decontamination Zone	X																			
Prepare Hillside Waste Rock Pile for Processing	Hillside Waste Rock Pile	X																			
Move Stockpile #7 to #6	Stockpiles # 7 and #6		X																		
Process Hillside Waste Rock Pile	Hillside Waste Rock Pile		X		X	X	X														
Rockfall Hazard Mitigation at Pit 4	Pit 4		X																		
Remove Pit 4 Overburden Piles	Pit 4 Overburden Piles		X	X																	
Remove Ore and Protore Stockpiles	Ore/Protore Stockpiles			X																	
Protore #1 to Pit 4	Protore #1 and Pit 4			X																	
Protore #2 to Pit 4	Protore #2 and Pit 4			X																	
Lime Protore #8 to Pit 4	Lime Protore #8 and Pit 4			X																	
Ore #3 to Pit 4	Ore #3 and Pit 4			X																	
Ore/Protore #4 to Pit 4	Ore/Protore #4 and Pit 4			X																	
South Dump Pond Regrade to Pit 4	South Dump Pond and Pit 4			X																	
Pit 4 Overburden to Pit 4	Pit 4 Overburden and Pit 4			X																	
Western Drainage Waste Rock to Pit 4	Western Drainage Waste Rock and Pit 4			X	X																
Construct South Pond	South Pond				X																
Cleanup Western Drainage to Pit 3	Western Drainage							X													
Excavate Pit 2 West and Adit Pit	Adit Pit and Pit 2 West			X	X																
Construct Borrow Area Haul Road	Borrow Area Haul Road		X		X																
Construct the New WTP and Ponds	Water Treatment Plan and Pond			X	X																
Construct the WTP Pipeline	Water Treatment Plant Effluent Pipeline			X	X																
Construct Alluvial Ground Water Interceptor System	Alluvial Ground Water Controls		X																		
Construct Temporary Pipelines from Pit 4, Alluvial Groundwater Interceptor and BPA to the South Pond	Temporary Influent Pipelines		X																		
Remove Mine Waste From Pit 4 North	Pit 4 North		X																		
Perform Rockfall Mitigation at Pit 3 and BPA	Pit 3 and BPA				X																
Remove Remaining Hillside Waste Rock Pile to Pit 3	Hillside Waste Rock Pile						X														
Regrade and Cover Adit Pit and Pit 2 West	Adit Pit and Pit 2 West						X	X													
Demolish Existing Structures	Existing Buildings	X																			
Excavate the East Waste Rock Pile and Place in Pit 3	East Waste Rock Pile								X												
Remove Contaminated Material from Internal and Eastern Haul Road	Site Roads										X										
Excavate Sediment from Western Drainage	Western Drainage Waste Rock							X													

Table 5-2. Tentative Grading Activity Schedule (cont.)

Activities	Locations	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Regrade Cap and Cover Area 5	Area 5								X												
Construct West Pond	West Pond								X												
Remove Contaminated from Eastern Drainage	Eastern Drainage Sediment Cleanup								X												
Remove Contaminated Material from Western Drainage	Western Drainage Sediment Cleanup							X													
Construct Temporary Pit 3 Influent Pipelines To South Pond	Temporary Influent Pipelines					X															
Develop Borrow Area - Phase Ii	Borrow Area and Haul Road										X										
Construct 4 Stormwater Attenuation Berms	Stormwater Attenuation Berms								X												
Decommission the Pollution Control Pond	Pollution Control Pond								X												
Decommission the South Pond	South Pond								X												
Remove Remaining South Waste Rock Pile	South Waste Rock Pile								X												
Removed Contaminated Sediments From Central Drainage	Central Drainage Sediment Cleanup								X												
Backfill, Cap and Cover Pit 3 and BPA	Backfilled and Covered Pit 3 and BPA						X	X													
Develop Borrow Area - Phase III and Reclaim Road	Borrow Area and Haul Road										X										
Construct Permanent Site Maintenance Roads	Temporary and Permanent Influent Pipelines and Site Maintenance Roads										X										
Construct Interim Fencing at WCA	Interim Fencing													X							
Construct Permanent Influent Pipes	Permanent Influent Pipelines				X	X															
Decommission the West Pond	West Pond																				X
Construct Permanent Barrier at WCA	Boulder Barrier													X							



WORTHINGTON MILLER ENVIRONMENTAL, LLC.	Figure 5-2 Midnite Mine Grading Phases	Date: January 2016 Project: Midnite Mine File: MMEmissions.MXD

6.0 REGULATORY MONITORING REPORTING

The results of the regulatory air monitoring will be compiled in the same quarterly monitoring report described above and will be submitted within 45 days after the end of each calendar quarter. These reports will include the following items as applicable:

- Initial engine emissions testing of rock crushing operation.
- Initial visible emissions and fugitive dust performance testing of rock crushing operation and overall site.
- Weekly visible emissions and fugitive dust monitoring of the rock crushing operation.
- Annual visible emissions and fugitive dust monitoring of the overall site.

7.0 REFERENCES

10 CFR 20, Nuclear Regulatory Commission (NRC), Standards for Protection Against Radiation, Appendix B - Annual Limits on Intake (ALIs) and Derived Air Concentrations (DACs) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage.

29 CFR 1910.1096, Occupational Safety and Health Standards Subpart Z - Toxic and Hazardous Substances, Ionizing Radiation.

Eastern Technical Associates and Entrophy Environmental, Inc. (ETA and Entrophy). Visible Emissions Field Manual, EPA Methods 9 and 22. Prepared for US EPA under contract 68-02-4462. December 1993.

FARR, 2005. Federal Air Rule for Indian Reservations in Idaho, Oregon, and Washington.

Kirkby, M.J. and Morgan, R.P.C., 1980. Soil Erosion.

MWH, 2015. Midnite Mine Superfund Site 100 Percent Basis of Design Report.

Occupational Safety and Health Administration (OSHA), 2015. Permissible Exposure Limits – Annotated Tables at https://www.osha.gov/dsg/annotated-pels/

Shepard Miller, Inc. (SMI). 1996. Revised Midnite Mine Reclamation Plan, Spokane Indian Reservation, Washington. Prepared for the Dawn Mining Company, Ford, Washington. Fort Collins, Colorado. June 3, 1996.

URS Corporation, 2005. Midnite Mine Remedial Investigation Report.

United States Environmental Protection Agency, 2015. United States Environmental Protection Agency General Permit for New or Modified Minor Sources of Air Pollution in Indian Country at:
http://www3.epa.gov/air/tribal/tribalnsr/StoneQuarryingPermit.pdf

United States Environmental Protection Agency (EPA). 2006. Midnite Mine Superfund Site Spokane Indian Reservation, Washington, Record of Decision. Prepared by Office of Environmental Cleanup, EPA Region 10. September 2006.

United States Environmental Protection Agency (EPA), 1993. EPA 340/1-92-0004, Visible Emissions Field Manual – EPA Methods 9 and 22. Prepared by Eastern Technical Associates and Entropy Environmental, December 1993.

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Appendix A:

EPA General Permit for New or Modified Minor Source Stone Quarrying, Crushing and Screening Facilities in Indian Country (SQCS General Permit)

United States Environmental Protection Agency
General Permit for New or Modified Minor Sources of Air Pollution in Indian Country
http://www.epa.gov/air/tribal/tribalnsr.html

General Air Quality Permit for New or Modified Minor Source Stone Quarrying, Crushing, and Screening Facilities in Indian Country

Last Modified: April 6, 2015

Information about this General Permit:

Applicability
Pursuant to the provisions of the Clean Air Act (CAA), Subchapter I, part D and 40 CFR part 49, subpart C, this permit authorizes the construction or modification and the operation of each stationary and portable stone quarrying, rock crushing, and screening plant for which a reviewing authority issues an Approval of the Request for Coverage (permitted source).

Eligibility
To be eligible for coverage under this General Permit, the permitted source must qualify as a minor source as defined in 40 CFR 49.152.

Request for Coverage
Requirements for submitting a Request for Coverage are contained in Section 7 of this General Permit.

Incorporation of Documents
The information contained in each reviewing authority's Approval of the Request of Coverage is hereby incorporated into this General Permit.

Termination
Section 6 of this General Permit addresses a reviewing authority's ability to revise, revoke and reissue, or terminate this General Permit. It also addresses the reviewing authority's ability to terminate an individual permitted source's Approval of the Request for Coverage under this General Permit.

Definitions
The terms used herein shall have the meaning as defined in 40 CFR 49.152, unless otherwise defined in Attachment B of this permit. If a term is not defined, it shall be interpreted in accordance with normal business use.

Permit Terms and Conditions

The following applies to each permittee and permitted source with respect to only the affected emissions units and any associated air pollution control technologies in that permitted source's Approval of the Request for Coverage.

Section 1: General Provisions

1. *Construction and Operation*
   The permittee shall construct or modify and shall operate the affected emissions units and any associated air pollution control technologies in compliance with this permit and all other applicable federal air quality regulations; and in a manner consistent with representations made by the permittee in the Request for Coverage, to the extent the reviewing authority relies upon these representations in issuing the Approval of the Request for Coverage.

2. *Locations*
   This permit only authorizes the permittee to construct or modify and to operate the permitted source in the location(s) listed in the reviewing authority's Approval of the Request for Coverage for that permitted source.

3. *Liability*
   This permit does not release the permittee from any liability for compliance with other applicable federal and tribal environmental laws and regulations, including the CAA.

4. *Severability*
   The provisions of this permit are severable. If any portion of this permit is held invalid, the remaining terms and conditions of this permit shall remain valid and in force.

5. *Compliance*
   The permittee must comply with all provisions of this permit, including those set forth in the attachments and emission limitations that apply to the affected emissions units at the permitted source. Noncompliance with any permit provision is a violation of the permit and may constitute a violation of the CAA; is grounds for an enforcement action; and is grounds for the reviewing authority to revoke the Approval of the Request for Coverage and terminate the permitted source's coverage under this General Permit.

6. *National Ambient Air Quality Standards (NAAQS)/Prevention of Significant Deterioration (PSD) Protection*
   The permitted source must not cause or contribute to a NAAQS violation or, in an attainment area, must not cause or contribute to a PSD increment violation.

7. *Unavailable Defense*
   It is not a defense for the permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the provisions of this permit.

8. *Property Rights*
   This permit does not convey any property rights of any sort or any exclusive privilege.

9. *Information Requests*
   You, as the permittee, shall furnish to the reviewing authority, within 30 days unless another timeframe is specified by the EPA, any information that the reviewing authority may request in writing to determine whether cause exists for revising, revoking and reissuing, or terminating coverage under the permit or to determine compliance with the permit. For any such information claimed to be confidential, the permittee must submit a claim of confidentiality in accordance with 40 CFR part 2 subpart B.

10. *Inspection and Entry*
    Upon presentation of proper credentials, the permittee must allow a representative of the reviewing authority to:
    a. Enter upon the premises where a permitted source is located or emissions-related activity is conducted or where records are required to be kept under the conditions of the permit;
    b. Have access to and copy, at reasonable times, any records that are required to be kept under the conditions of the permit;
    c. Inspect, during normal business hours or while the permitted source is in operation, any facilities, equipment (including monitoring and air pollution control equipment), practices or operations regulated or required under the permit;
    d. Sample or monitor, at reasonable times, substances or parameters for the purpose of assuring compliance with the permit or other applicable requirements and
    e. Record any inspection by use of written, electronic, magnetic and photographic media.

11. *Posting of Coverage*
    The most current Approval of the Request for Coverage for the permitted source, must be posted prominently at the facility, and each affected emissions unit and any associated air pollution control technology must be labeled with the identification number listed in the Approval of the Request for Coverage for that permitted source.

12. *Duty to Obtain Source-specific Permit*
    If the reviewing authority intends to terminate a permitted source's coverage under this General Permit for cause as provided in Section 6 of this General Permit, then the permittee shall apply for and obtain a source-specific permit as required by the reviewing authority.

13. *Credible Evidence*
    For the purpose of establishing whether the permittee violated or is in violation of any requirement of this permit, nothing shall preclude the use, including the exclusive use, of any credible evidence or information relevant to whether a permitted source would have been in compliance with applicable requirements if the permittee had performed the appropriate performance or compliance test or procedure.

Section 2: Emission Limitations and Standards

14. The permittee shall install, maintain, and operate each affected emissions unit, including any associated air pollution control equipment, in a manner consistent with good air pollution control practices for minimizing emissions of New Source Review regulated pollutants and considering the manufacturer's recommended operating procedures at all times, including periods of startup, shutdown, maintenance and malfunction. The reviewing authority will determine whether the permittee is using acceptable operating and maintenance procedures based on information available to the reviewing authority which may include, but

is not limited to, monitoring results, opacity observations, review of operating and maintenance procedures, and inspection of the permitted source.

15. Except as specified in Condition 16, maximum raw material throughput shall not exceed 1,100,000 tons-per-month based on a 12-month rolling average.

16. The following throughput limit applies when sources are co-located with hot mix asphalt plants and have elected to comply with this limit: maximum raw material throughput shall not exceed 730,000 tons-per-month based on a 12-month rolling average. The requirement to comply with this limit shall be specified in the Approval of the Request for Coverage.

17. Fuel combustion in stationary internal combustion engines shall be limited to diesel and biodiesel.

18. Diesel and biodiesel shall contain no more than 0.0015 percent sulfur by weight.

19. The combined fuel consumption in all engines and generators, excluding nonroad mobile engines, in any calendar month shall not exceed:
    a. 24,200 gallons if the permitted source is located in an ozone attainment, unclassifiable or attainment/unclassifiable area or a marginal or moderate ozone nonattainment area; or
    b. 12,000 gallons if the permitted source is located in a serious ozone nonattainment area;
    c. 5,500 gallons if the permitted source is located in a severe ozone nonattainment area;
    d. 1,900 gallons if the permitted source is located in an extreme ozone nonattainment area; or
    e. 18,275 gallons if the Approval of Request for Coverage requires the permitted source to comply with this condition, Condition 19.e. This fuel consumption limit includes any fuel use at a co-located Hot Mix Asphalt operation.

20. Emissions from all crushers, screens, drop points, and other possible release points shall be controlled by wet suppression.

21. Fugitive emissions from stone quarrying, rock crushing, and screening operations shall not exceed:
    a. 12 percent opacity for crushers; and
    b. 7 percent opacity, at other affected emissions units.

22. Truck dumping of nonmetallic minerals into any screening operation, feed hopper, or crusher is exempt from the emission limits in Condition 21.

23. The permittee shall comply with the fugitive dust control plan in Attachment C.

24. Each affected compression ignition engine, excluding nonroad mobile engines, shall comply with the following limitations and standards:
    a. Each compression ignition engine that commenced construction on or after June 12, 2006 must be certified to the applicable Tier standards in 40 CFR 89.112 and 40 CFR 1039.101 through 1039.104, for all pollutants, for the same model year and maximum engine power.
    b. Each compression ignition engine that commenced construction before June 12, 2006 shall meet the following standards based on the engine's maximum rated power.

Maximum Engine Power Rating	Emission Standard
≤ 300 HP	(a) Change oil and filter every 1,000 hours of operation or annually, whichever comes first; (b) Inspect air cleaner every 1,000 hours of operation or annually, whichever comes first; (c) Inspect all hoses and belts every 500 hours of operation or annually, whichever comes first, and replace as necessary.
300 < HP ≤ 500	Limit carbon monoxide (CO) to 49 ppm_{vd} @ 15% O_2 OR reduce CO emissions by 70 percent or more. Emissions shall be controlled through the use of an oxidation catalyst. Engines certified to Tier 3 standards in 40 CFR 89.112 are exempt from this limit.
HP > 500	Limit CO to 23 ppm_{vd} @ 15% O_2 OR reduce CO emissions by 70 percent or more. Emissions shall be controlled through the use of an oxidation catalyst. Engines rated at less than or equal to 560kW that are certified to Tier 3 standards in 40 CFR 89.112 are exempt from this limit. Engines rated at greater than 560kW that are certified to Tier 2 standards in 40 CFR 89.122 are exempt from this limit.

25. No affected compression ignition engine, excluding nonroad mobile engines, shall discharge into the atmosphere any gases that exhibit 20 percent opacity or greater averaged over any six-consecutive-minute period.

Section 3: Monitoring and Testing Requirements

26. *Wet Suppression Monitoring*
    At least once during each calendar month the permitted source operates, the permittee shall inspect to check that water is flowing to discharge spray nozzles in the wet suppression system. The owner or operator must initiate corrective action within 24 hours and complete corrective action as expediently as practical.

27. *Visible Emissions Survey*
    At least once during each calendar week in which the permitted source operates, the permittee shall perform a visible emissions survey of all affected emissions units subject to the opacity limit in Condition 21. The survey shall be performed during daylight hours by an individual trained in EPA Method 22 while the permitted source is in operation. If visible emissions are detected during the survey, the permittee shall either:
    a. Take corrective action so that within 24 hours no visible emissions are detected from any affected emissions units while they are in operation; or
    b. Demonstrate compliance with the opacity limit at all affected emissions units that discharged visible emissions during the survey using EPA Method 9 by an individual trained and certified in Method 9.

28. *Fugitive Emissions Survey*
At least once during each calendar week in which the permitted source operates, the permittee shall survey the facility for visible fugitive emissions. If fugitive emissions are detected crossing the property line, the permittee shall take corrective actions according to the attached fugitive dust control plan (Attachment C).

29. *Initial Performance Test*
Within 60 days after achieving the maximum production rate at which the permitted source will operate the affected emissions unit(s), but not later than 180 days after the first day of operation after the reviewing authority issues the Approval of the Request for Coverage, the permittee shall perform an initial performance test to verify compliance with the applicable opacity limitations in Condition 21. Performance tests shall be performed:
    a. According to a test plan approved by the reviewing authority;
    b. While the permitted source is operating under typical operating conditions;
    c. Using test Method 9 from 40 CFR part 60, appendix A with the following modifications:
        i. The observer shall stand at least 15 feet from the emissions source;
        ii. The observer shall, when possible, select a position that minimizes interference from other fugitive emissions sources; and
        iii. Water used for wet suppression shall not be confused with particulate matter emissions and is not to be considered a visible emission. When a water mist of this nature is present, the observation of emissions is to be made at a point in the plume where the mist is no longer visible; and
    d. The duration of each Method 9 test shall be at least 30 minutes.

Compliance with each opacity limit shall be determined based on the average of at least five six-minute averages.

30. *Additional Performance Test(s)*
Ongoing performance tests meeting the criteria of the initial performance tests in Condition 29 shall be performed whenever required by the reviewing authority but at least every five years.

31. *Performance Test for Engines*
Within 60 days after achieving the maximum production rate at which the permitted source will operate, but not later than 180 days after the first day of operation after the Approval of Request for Coverage is issued by the reviewing authority the permittee shall perform a performance test to verify compliance with the CO and emission limits in Condition 24, as applicable, as follows:
    a. According to a test plan approved by the reviewing authority;
    b. While the stone quarrying, crushing, and screening facility is operating under typical operating conditions;
    c. Using test methods from 40 CFR part 60, appendix A, or portable analyzers allowed by 40 CFR part 63, subpart ZZZZ, unless alternative methods are approved by the reviewing authority in writing in advance of the test;
    d. While the catalyst inlet temperature and pressure drop are being monitored and recorded;
    e. Upon completion of the performance test, the permittee shall establish the operating range for the catalyst inlet temperature based on a 4-hour average and the pressure drop across the catalyst; and
    f. The permittee shall conduct subsequent performance tests according to this paragraph whenever required by the reviewing authority.

The permitted source may substitute the results of the most recent performance test performed on the engine(s) in lieu of conducting the performance test for engines required above, provided that the most recent performance test was conducted within two years of the first day of operation after the Approval of Request for Coverage is issued by the reviewing authority, and, was conducted according to the requirements in Conditions 31.a-f. above.

32. *Continuous Parameter Monitoring at Engines*
For each engine greater than 500 hp subject to a CO emission limitation, the permittee shall install, operate, and maintain a continuous parameter monitoring system according to the methods in 40 CFR 63.6625(b) to continuously monitor catalyst inlet temperature. Catalyst temperature data shall be reduced to 4-hour rolling averages. The permittee shall maintain the 4-hour rolling average catalyst inlet temperature within the operating parameter established during the most recent performance test.

33. *Pressure Drop Monitoring at Engines*
For each engine greater than 500 hp subject to a CO emission limitation, the permittee shall monitor the pressure drop across the catalyst on a monthly basis. The permittee shall ensure the pressure drop across the catalyst is within the operating parameter established during the most recent performance test.

Section 4: Recordkeeping Requirements

34. The permittee shall maintain all records required to be kept by this permit for at least five years from the date of origin, unless otherwise stated, either onsite or at a convenient location, such that they can be delivered to the reviewing authority within 24 hours of a request.

35. The permit application and all documentation supporting that application shall be maintained by the permittee for the duration of time the affected emissions unit(s) is covered under this permit.

36. Each month the permitted source shall record the amounts of crushed rock, stone, sand, and gravel processed (in tons) and the 12-month rolling average.

37. The types and quantities of fuel combusted in engines and generators shall be recorded each calendar month.

38. The dates and results of each wet suppression system monitoring performed pursuant to Condition 26, any corrective action taken as a result of each survey, and the result of any corrective action taken shall be recorded.

39. The dates and results of each visible emissions survey performed pursuant to Condition 27 shall be recorded. At a minimum, records shall include:
    a. The name of the person, company or entity conducting the survey;
    b. Whether visible emissions were detected from any affected emissions unit;
    c. Any corrective action taken;
    d. The result of any corrective action; and
    e. The results of any Method 9 tests performed.

40. The dates and results of each fugitive emissions survey performed pursuant to Condition 28, any corrective action taken as a result of each survey, and the result of any corrective action taken shall be recorded.

41. The results of each performance test conducted pursuant to Condition 29, 30, or 31 shall be recorded. At a minimum, the permittee shall maintain records of:
    a. The date of each test;
    b. Each test plan;
    c. Any documentation required to approve an alternate test method;
    d. Test conditions, including the amounts and types of products produced and the operating parameters of any control equipment;
    e. The results of each test; and
    f. The name of the company or entity conducting the analysis.

42. A log of all maintenance activities conducted on each engine, excluding nonroad mobile engines, shall be recorded.

43. The date, time, and duration of each deviation from the established catalyst operating parameters for each engine, corrective actions taken to return the equipment to normal operation and the results of any corrective action taken shall be recorded.

Section 5: Notification and Reporting Requirements

44. *Notification of Construction or Modification, and Operations*
    The permittee shall submit a written or electronic notice to the reviewing authority within 30 days from when the permittee begins actual construction, and within 30 days from when the permittee begins initial operations or resumes operation after a modification.

45. *Notification of Relocation*
    When a permittee intends to relocate the permitted source to an alternate location contained in the Approval of the Request for Coverage, then the permittee must notify the reviewing authority electronically within 30 days before or after such relocation. The notification must identify the owner, the preceding location, and the new location of the permitted source.

46. *Notification of Change in Ownership or Operator*
    If the permitted source changes ownership or operator, then the new owner or operator must submit a written or electronic notice to the reviewing authority within 90 days after the change in ownership or operator is effective. In the report, the new permittee must provide the reviewing authority a written agreement containing a specific date for transfer of ownership or operator, and an effective date on which the new owner or operator assumes partial and/or full coverage and liability under this permit. The submittal must identify the previous owner or operator, and update the name, street address, mailing address, contact information, and any other information about the permitted source if it would change as a result of the change of ownership or operator. The current owner or operator shall ensure that the permitted source remains in compliance with the General Permit until any such transfer of ownership or operator is effective.

47. *Notification of Closure*
The permittee must submit a report of any permanent or indefinite closure to the reviewing authority in writing within 90 days after the cessation of all operations at the permitted source. The notification must identify the owner, the current location, and the last operating location of the permitted source. It is not necessary to submit a report of closure for regular, seasonal closures.

48. *Annual Reports*
The permittee shall submit an annual report on or before March 15 of each calendar year to the reviewing authority. The annual report shall cover the period from January 1 to December 31 of the previous calendar year and shall include:
a. An evaluation of the permitted source's compliance status with the requirements in Section 2 for each location in which the permitted source located during the calendar year;
b. Summaries of the required monitoring and recordkeeping in Sections 3 and 4; and
c. Summaries of deviation reports submitted pursuant to Condition 49.

49. *Deviation Reports*
The permittee shall promptly report to the reviewing authority any deviations as defined at 40 CFR 71.6(a)(3)(iii)(C) from permit requirements including deviations attributable to upset conditions. Deviation reports shall include:
a. The identity of affected emissions unit where the deviation occurred.
b. The nature of the deviation;
c. The length of time of the deviation;
d. The probable cause of the deviation; and
e. Any corrective actions or preventive measures taken as a result of the deviation to minimize emissions from the deviation and to prevent future deviations.
f. For the purposes of this permit, *promptly* shall be defined to mean:
    i. Within 72 hours of discovery for deviations from any emission limit in Condition 20 and any opacity limit in Condition 21; or
    ii. Within 30 days after the end of the month in which the permittee discovered the deviation, for all other deviations.

50. *Performance Test Reports*
The permittee shall submit a test report to the reviewing authority within 45 days after the completion of any required performance test. At a minimum, the test report shall include:
a. A description of the affected emissions unit and sampling location(s);
b. The time and date of each test;
c. A summary of test results, reported in units consistent with the applicable standard;
d. A description of the test methods and quality assurance procedures used;
e. A summary of any deviations from the proposed test plan and justification for why the deviation(s) was necessary;
f. The amount of fuel burned, raw material consumed, and product produced during each test run;
g. Operating parameters of the affected emissions unit and control equipment during each test run;
h. Sample calculations of equations used to determine test results in the appropriate units; and
i. The name of the company or entity performing the analysis.

51. *Reporting and Notification Address*
The permittee shall send all required reports to the reviewing authority at the mailing address(es) specified in the Approval of the Request for Coverage.

52. *Signature Verifying Truth, Accuracy, and Completeness*
All reports required by this permit shall be signed by a responsible official as to the truth, accuracy, and completeness of the information. The report must state that, based on information and belief formed after reasonable inquiry, the statements and information are true, accurate, and complete. If the permittee discovers that any reports or notification submitted to the reviewing authority contain false, inaccurate, or incomplete information, the permittee shall notify the reviewing authority immediately and correct or amend the report as soon as practicable.

Section 6: Changes to this General Permit

53. *Revising, Reopening, Revoking and Reissuing, or Terminating for Cause*
The permit may be revised, reopened, revoked and reissued, or terminated for cause. The filing of a request by you, the permittee, for a permit revision, revocation and re-issuance, or termination, or of a notification of planned changes or anticipated noncompliance does not stay any permit condition. This provision also applies to the documents incorporated by reference.

54. *Terminating Coverage Under this Permit*
The reviewing authority may terminate a previously issued Approval of the Request for Coverage, and thereby terminate that permittee's authorization to construct or modify, and that permitted source's authorization to operate under this General Permit for cause as defined in Attachment B. The reviewing authority may provide the permittee with notice of the intent to terminate, and delay the effective date of the termination to allow the permittee to obtain a source-specific permit as required by the reviewing authority.

55. *Change in Ownership or Operator*
If the permitted source changes ownership or operator, the reviewing authority may change the Approval of the Request of Coverage to reflect the new ownership or operator in accordance with the administrative amendment provisions in 40 CFR 49.159(f).

56. *Permit Becomes Invalid*
Authority to construct and operate under this permit becomes invalid if the permittee does not commence construction within 18 months after the effective date of the request for coverage under a general permit, if the permittee discontinues construction for a period of 18 months or more, or if the permittee does not complete construction within a reasonable time. The reviewing authority may extend the 18-month period upon a satisfactory showing that an extension is justified, according to 40 CFR 49.156(e)(8).

Section 7: Obtaining Coverage under this General Permit

57. To obtain coverage under this General Permit, an applicant must submit a Request for Coverage to the appropriate reviewing authority for the area in which the permitted source is or will be located (the Request for Coverage Form can be found at: http://www.epa.gov/air/tribal/tribalnsr.html). Attachment D contains a list of reviewing authorities and their area of coverage.

58. If the plant will locate in area covered by more than one reviewing authority, the applicant need only submit a Request for Coverage to one reviewing authority with regard to all intended locations of operation. The Request for Coverage must contain the information requested in the standard application form for this permit. You must also submit a copy of the Request for Coverage to the Indian governing body for every area in which the permitted source plans operate.

Attachment A: Abbreviations and Acronyms

ASTM	American Society for Testing and Materials
CAA or the Act	Federal Clean Air Act
CFR	Code of Federal Regulations
CO	carbon monoxide
EPA	United States Environmental Protection Agency
gr/dscf	gram per dry standard cubic foot
Hg	mercury
hp	horsepower
kW	kilowatt
NAAQS	National Ambient Air Quality Standards
NSR	New Source Review
ppm	parts per million
ppm_{vd}	parts per million by volume, dry basis
PSD	Prevention of Significant Deterioration

Attachment B: Definitions

For the purposes of this General Permit:

Approval of the Request for Coverage means a reviewing authority's letter granting an applicant's request for construction or modification, and operation of a minor source under the terms and conditions of this General Permit.

Biodiesel means a combustion fuel made from fatty acids of methyl esters that complies with the specifications of ASTM 6751

Cause means with respect to the reviewing authority's ability to terminate a permitted source's coverage under a permit that:

1. The permittee is not in compliance with the provisions of this General Permit;
2. The reviewing authority determines that the emissions resulting from the construction or modification of the permitted source significantly contribute to NAAQS violations, which are not adequately addressed by the requirements in this General Permit;
3. The reviewing authority has reasonable cause to believe that the permittee obtained Approval of the Request for Coverage by fraud or misrepresentation; or
4. The permittee failed to disclose a material fact required by the Request for Coverage or the regulations applicable to the permitted source of which the applicant had or should have had knowledge at the time the permittee submitted the Request for Coverage.

Construction means any physical change or change in the method of operation including fabrication, erection, installation, demolition, or modification of an affected emissions unit that would result in a change of emissions.

Permittee means the owner or operator of a permitted source.

Permitted source means each stationary and portable stone quarrying, rock crushing and screening facility for which a reviewing authority issues an Approval of the Request for Coverage.

Request for Coverage means a permit application that contains all the information required in the standard application form.

Responsible official means one of the following:

1. For a corporation: a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation, or a duly authorized representative of such person if the representative is directly responsible for the overall operation of the permitted source.
2. For a partnership or sole proprietorship: a general partner or the proprietor, respectively.
3. For a public agency: Either a principal executive officer or ranking elected official, such as a chief executive officer having responsibility for the overall operations of a principal geographic unit of the agency.

Standard cubic foot means a measure of the quantity of a gas equal to a cubic foot of volume at a temperature of 68 °F and a pressure of 29.92 in. Hg.

Attachment C: Dust Control Plan

1. *Site Roadways and Plant Yard*
   a. The dust on the site roadways/plant yard shall be controlled by applications of water, calcium chloride or other acceptable fugitive dust control compound approved by the reviewing authority. Applications of dust suppressants shall be done as often as necessary to meet all applicable emission limits.
   b. All paved roadways/plant yards shall be swept as needed between applications.
   c. Any material spillage on roads shall be cleaned up immediately.

2. *Plant*
   a. The drop distance at each transfer point shall be reduced to the minimum the equipment can achieve.
   b. The transfer point from the re-circulating belt to the feed belt shall be equipped with an enclosed chute.

3. *Storage Piles*
   a. Stockpiling of all nonmetallic minerals shall be performed to minimize drop distance and control potential dust problems.
   b. Stockpiles shall be watered on an as needed basis in order to meet the opacity limits. Also, equipment to apply water or dust suppressant shall be available at the site, or on call for use at the site, within a given operating day.

4. *Truck Traffic*
   a. Vehicles shall be loaded to prevent their contents from dropping, leaking, blowing or otherwise escaping. This shall be accomplished by loading so that no part of the load shall come in contact within six (6) inches of the top of any side board, side panel or tail gate; otherwise, the truck shall be tarped.
   b. A speed limit sign of 15 miles-per-hour or lower shall be posted on site so that it is visible to truck traffic.

5. *Corrective Actions*
   If corrective action needs to be taken, the permittee shall consider and use one or more of the following options: adjust the watering and/or sweeping frequencies, reduce drop distances, increase cover, and/or take other actions to reduce fugitive dust emissions.

Attachment D – List of Reviewing Authorities and Areas of Coverage

EPA Region	Address for Notification of Coverage	Address for All Other Notifications and Reports	Area Covered	Phone Number
Region I	EPA New England 5 Post Office Square, Suite 100 Mail Code OEP05-2 Boston, MA 02109-3912	EPA New England 5 Post Office Square, Suite 100 Mail Code OES04-2 Boston, MA 02109-3912	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont	888- 372-7341 617-918-1111
Region II	Chief, Air Programs Branch Clean Air and Sustainability Division EPA Region 2 290 Broadway, 25th Floor New York, NY 10007-1866	Chief, Air Compliance Branch Division of Enforcement and Compliance Assistance EPA Region 2 290 Broadway, 21st Floor New York, NY 10007-1866	New Jersey, New York, Puerto Rico, and Virgin Islands	877-251-4575
Region III	Office of Permits and Air Toxics 3AP10 EPA Region 3 1650 Arch Street Philadelphia, PA 19103	Office of Air Enforcement and Compliance Assurance 3AP20 EPA Region 3 1650 Arch Street Philadelphia, PA 19103	Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, and West Virginia	800-438-2474 215-814-5000
Region IV	Chief, Air Permits Section EPA Region 4 APTMD 61 Forsyth Street Atlanta, GA 30303	Chief, Air & EPCRA Enforcement Branch EPA Region 4 APTMD 61 Forsyth Street, SW Atlanta, GA 30303	Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee	800-241-1754 404-562-9000
Region V	Air Permits Section Air Programs Branch (AR-18J) EPA Region 5 77 West Jackson Blvd Chicago, Illinois 60604	Air Enforcement and Compliance Assurance Branch (AE-17J) Air and Radiation Division EPA Region 5 77 West Jackson Blvd Chicago, Illinois 60604	Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin	800-621-8431 312-353-2000

EPA Region	Address for Notification of Coverage	Address for All Other Notifications and Reports	Area Covered	Phone Number
Region VI	Multimedia Planning and Permitting Division EPA Region 6 1445 Ross Avenue (6PD-R) Dallas, TX 75202	Compliance and Enforcement Correspondence: Compliance Assurance and Enforcement Division EPA Region 6 1445 Ross Avenue (6EN) Dallas, TX 75202	Arkansas, Louisiana, New Mexico, Oklahoma, and Texas	800-887-6063 214-665-2760
Region VII	Chief, Air Permitting & Compliance Branch EPA Region 7 11201 Renner Blvd Lenexa, KS 66219	Chief, Air Permitting & Compliance Branch EPA Region 7 11201 Renner Blvd Lenexa, KS 66219	Iowa, Kansas, Missouri, and Nebraska	800-223-0425 913-551-7003
Region VIII	U.S. Environmental Protection Agency, Region 8 Office of Partnerships and Regulatory Assistance Tribal Air Permitting Program, 8P-AR 1595 Wynkoop Street Denver, Colorado 80202	U.S. Environmental Protection Agency, Region 8 Office of Enforcement, Compliance & Environmental Justice Air Toxics and Technical Enforcement Program, 8ENF-AT 1595 Wynkoop Street Denver, Colorado 80202	Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming	800-227-8917 303-312-6312
Region IX	Chief, Permits Office (Air-3) Air Division EPA Region 9 75 Hawthorne St San Francisco, CA 94105	Enforcement Division Director Attn: Air & TRI Section (ENF-2-1) EPA Region 9 75 Hawthorne St San Francisco, CA 94105	American Samoa, Arizona, California, Guam, Hawaii, Navajo Nation Nevada, and Northern Mariana Islands	866-EPA-9378 415-947-8000
Region X	Tribal Air Permits Coordinator U.S. EPA, Region 10, AWT-150 1200 Sixth Avenue, Suite 900 Seattle, WA 98101	Tribal Air Permits Coordinator U.S. EPA, Region 10, AWT-150 1200 Sixth Avenue, Suite 900 Seattle, WA 98101	Alaska, Idaho, Oregon, and Washington	800-424-4372 206-553-1200

Appendix B:

SOP and QA Plan for Real Time TSP Monitoring and Alarming System

APPENDIX B

STANDARD OPERATING PROCEDURE AND QUALITY ASSURANCE PLAN

MIDNITE MINE REAL TIME TOTAL SUSPENDED PARTICULATE AMBIENT MONITORING AND ALARMING SYSTEM

Rev. 0

B.0 CONTENTS

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B.1 INTRODUCTION

B.1.1 Document Scope and Applicability

Bison Engineering, Inc. is conducting real-time ambient monitoring for Total Suspended Particulate (TSP) at the Midnite Mine site using a network of Met One, Inc. E-Samplers. The ambient monitoring also includes a meteorological system which is described in Section B.9. The Midnite Mine is an historical uranium mining facility located in northeastern Washington, approximately 40 miles northwest of Spokane and 8 miles northwest of the community of Wellpinit. The E-Sampler network will monitor real-time TSP concentrations during remediation activities at the site. Figure B.1-1 shows the location of the three fixed E-Samplers at the Midnite Mine site. Three roving samplers will also be deployed at other locations in close proximity to remedial action activities.

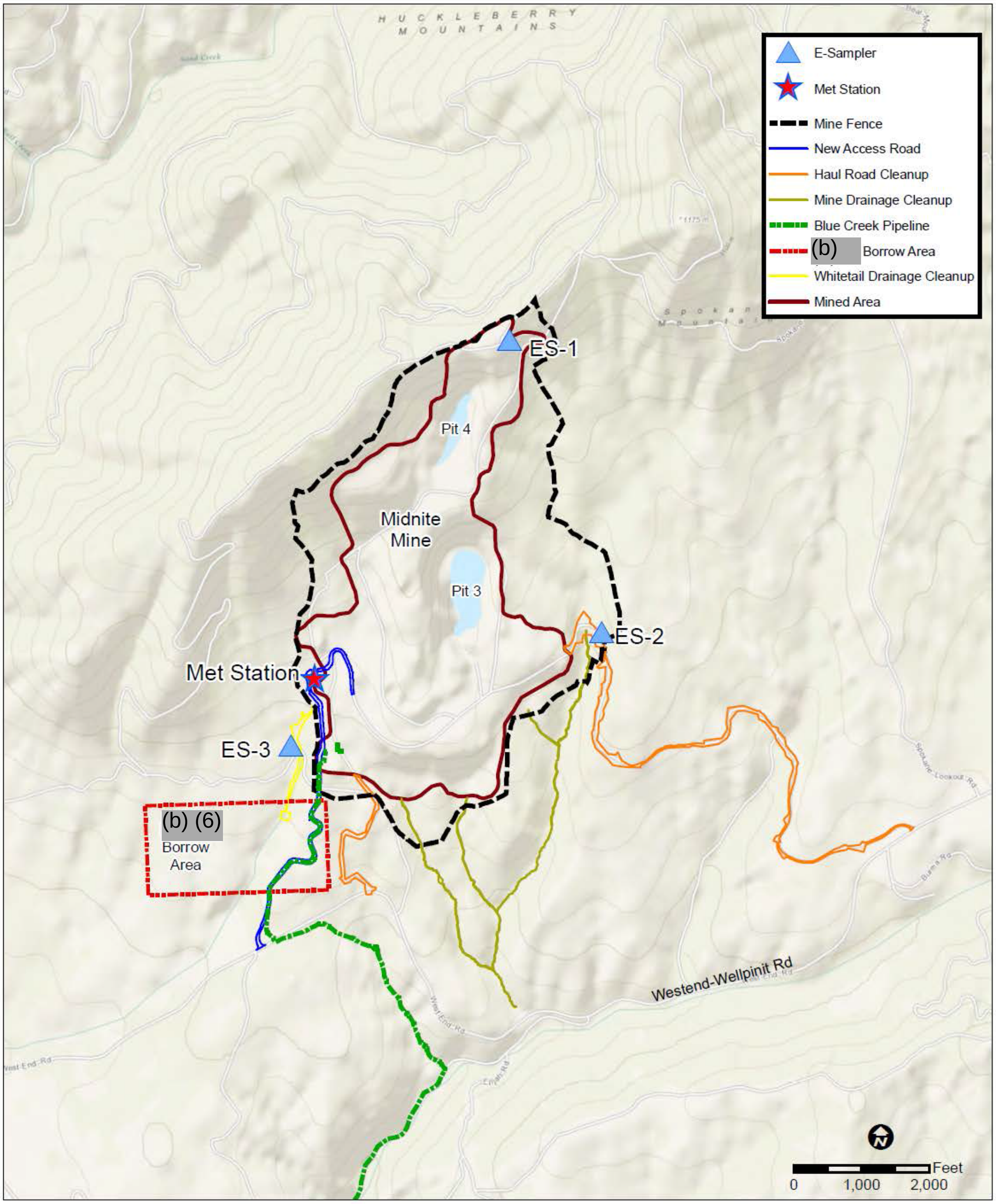
This Standard Operating Procedure (SOP) presents the operational, quality control and quality assurance aspects of the Midnite Mine E-Sampler units. The E-Sampler network is being used to facilitate effective fugitive dust control at the site, and to notify site personnel when airborne TSP concentrations reach levels indicating potentially hazardous concentrations of Contaminants of Potential Concern (COPC). The alarm notification procedure is described in Section B.7.

The E-Sampler is not designated as an EPA reference or equivalent method for the measurement of airborne particulates, and the network is not being used to evaluate compliance with National Ambient Air Quality Standards. However, it has been demonstrated to produce data comparable to that from an approved reference monitor (Reference 1) when used to measure particulates smaller than 2.5 microns in diameter ($PM_{2.5}$). Additionally, the E-Sampler includes an optional filter-based particulate collection system that will be used to determine a correction factor (multiplier) that will be applied to its TSP measurements, as discussed in Section B.4 of this SOP.

The Operator's Manual for the Met One E-Sampler (Reference 2) is a valuable resource, and should be consulted when more detailed information beyond that presented in this SOP is required.

B.1.2 Document Conventions

In this document, mandatory method requirements are referred to using the terms "must" and "shall." Typically, a supporting reference is included. The use of the word "should" indicates a strong recommendation. The word "may" indicates activities or suggestions that may be helpful but are optional.



WORTHINGTON MILLER ENVIRONMENTAL, LLC.	Figure B.1-1 Fixed Air Samplers and Meteorological Station	Date: November 2015 Project: Midnite Mine File: Project Geology.MXD

B.1.3 Method Limitations

Several conditions will limit the accuracy and/or precision of the measurements of ambient TSP concentrations that can be made by the E-Sampler monitors. Care has been taken with the design of the samplers and with the procedures presented in this document to minimize these effective limitations.

These limitations include:

- Accurate data analysis requires that the sample flow rate be maintained at the design value of 2.0 liters per minute (LPM). This document presents guidance for maintaining the air flow rate within specific tolerances through quality control activities (see Sections B.3 and B.6 of this SOP).

- Excessive moisture can result in interference to the instrument. The monitor includes a heater which is set to dry ambient air to a relative humidity of 35% to prevent condensation, and it works effectively the vast majority of the time. However, the heater can occasionally be overwhelmed by dense fog, heavy snow and – to a lesser degree – rain. The E-Sampler is fundamentally a nephelometer, and excessive moisture can attenuate the light beam path and result in false high TSP readings. Normally these readings are easily detected, because 1) dense fog and heavy snow are visually obvious, and 2) the readings occur in the absence of construction activity and/or high winds that normally accompany high TSP readings.

- The E-Sampler will stop operating at temperatures below -30°C (-22°F). Such extreme conditions are rare at the Midnite Mine.

B.1.4 Summary of Method

Design specifications for the E-Sampler network at the Midnite Mine include:

- Each E-Sampler is operated to obtain 5-minute averages of airborne TSP, which are stored in the sampler's internal memory. Each time a new 5-minute average is generated, that value is transmitted via radio to the Campbell Scientific CR1000 data logger at the Base station. The CR1000 maintains a running 60-minute TSP average, based on the past twelve 5-minute averages received from the E-Sampler. Whenever a running 60-minute TSP average exceeds the 260 microgram per cubic meter (μg/m^3) trigger level, an alarm notification is sent to the appropriate on-site personnel. (Alarm notification and response procedures are presented in Section B.7.)

- The E-Sampler inlet is equipped with the standard TSP inlet head ($PM_{2.5}$ and PM_{10} heads are also available).

- During normal operation, the E-Sampler is operated without the optional particulate collection filter. However, a filter test will be conducted at the onset of monitoring as described in Section B.4 (that procedure does not affect the E-Sampler's normal data collection).

- The self-test interval is normally set at one hour. This procedure also cleans the optical assembly with clean air.

Method requirements include:

- The sampler is operated to obtain TSP measurements at actual barometric pressure and temperature (rather than standard) ambient conditions.

- The sampling flow rate must be maintained at 2.0 LPM, +/- 4%.

B.1.5 Principles of Operation

The Met One Instruments, Inc. Model E-Sampler is a type of nephelometer which automatically measures and records real-time airborne TSP particulate concentration levels using the principle of forward laser light scatter. In addition, the E-Sampler has a built-in 47 mm filter sampler which can optionally be used to collect the particulate for subsequent gravimetric mass or laboratory evaluation.

Sample air is drawn into the E-Sampler and through the laser optical module, where the particulate in the sample air stream scatters the laser light through reflective and refractive properties. This scattered light is collected onto a photodiode detector at a near-forward angle, and the resulting electronic signal is processed to determine a continuous, real-time measurement of airborne particulate mass concentrations.

After the sample air stream has been measured by the E-Sampler and exits the optical engine, it passes through the built-in 47 mm filter sampler system. This system allows the particulate to optionally be collected on a filter disc as a second method to obtain airborne particulate mass data, or for laboratory analysis of the particulate. The 47 mm filter system can also be used to determine a gravimetric K-factor (slope multiplier) to correct the E-Sampler real-time signal to match the local particulate type. In this case, a filter disc is weighed on a microbalance before and after being run in the E-Sampler for a period of time. The resulting mass of the dust on the filter is correlated with the concentrations that the E-Sampler recorded over the same time period, and a correction factor is calculated. The E-Sampler can be used with no correction factor in applications where relative particulate trending is appropriate.

B.1.6 Warnings, Cautions, and Notices

The E-Sampler, when properly installed and operated, is considered a Class I laser product. Class I products are not considered to be hazardous.

Warning: This system contains a diode laser operating at 5 mW power and 670 nm wavelength. This is visible to the naked eye and can cause damage to the eye if directly exposed. A protective optical housing fully encapsulates the laser beam and optics system within the E-SAMPLER. Do not attempt to disassemble the optical module. Failure to comply with this instruction could cause accidental exposure to laser radiation. The manufacturer certifies that this product operates in compliance with following standards and regulations:

- FDA / CDRH This product is tested and complies with 21 CFR, Subchapter J, of the Health and Safety Act of 1968.
- US 21 CFR 1040.10.

Warning: Only trained technicians should attempt to repair the E-Sampler. Routine maintenance does not require removing the instrument from its weatherproof enclosure.

Warning: AC voltage can be dangerous and special care should be taken to avoid personal injury. The sampler power switch should be in the off position when AC power is applied. Normally the E-Samplers will be operated using 12-volt battery power rather than AC power. However, they may occasionally be used with AC voltage for testing.

Warning: Place power cords away from traffic and do not allow anything to rest on them during operation.

Warning: Always unplug the power to the sampler when servicing or replacing parts in areas requiring removal of protective panels.

Warning: Make all connections in accordance with national codes. Always use a third/wire grounding arrangement and always use a grounded outlet and cord.

Warning: Any exposed cords may need to be placed in a conduit to prevent damage from wildlife, particularly on the fixed monitors.

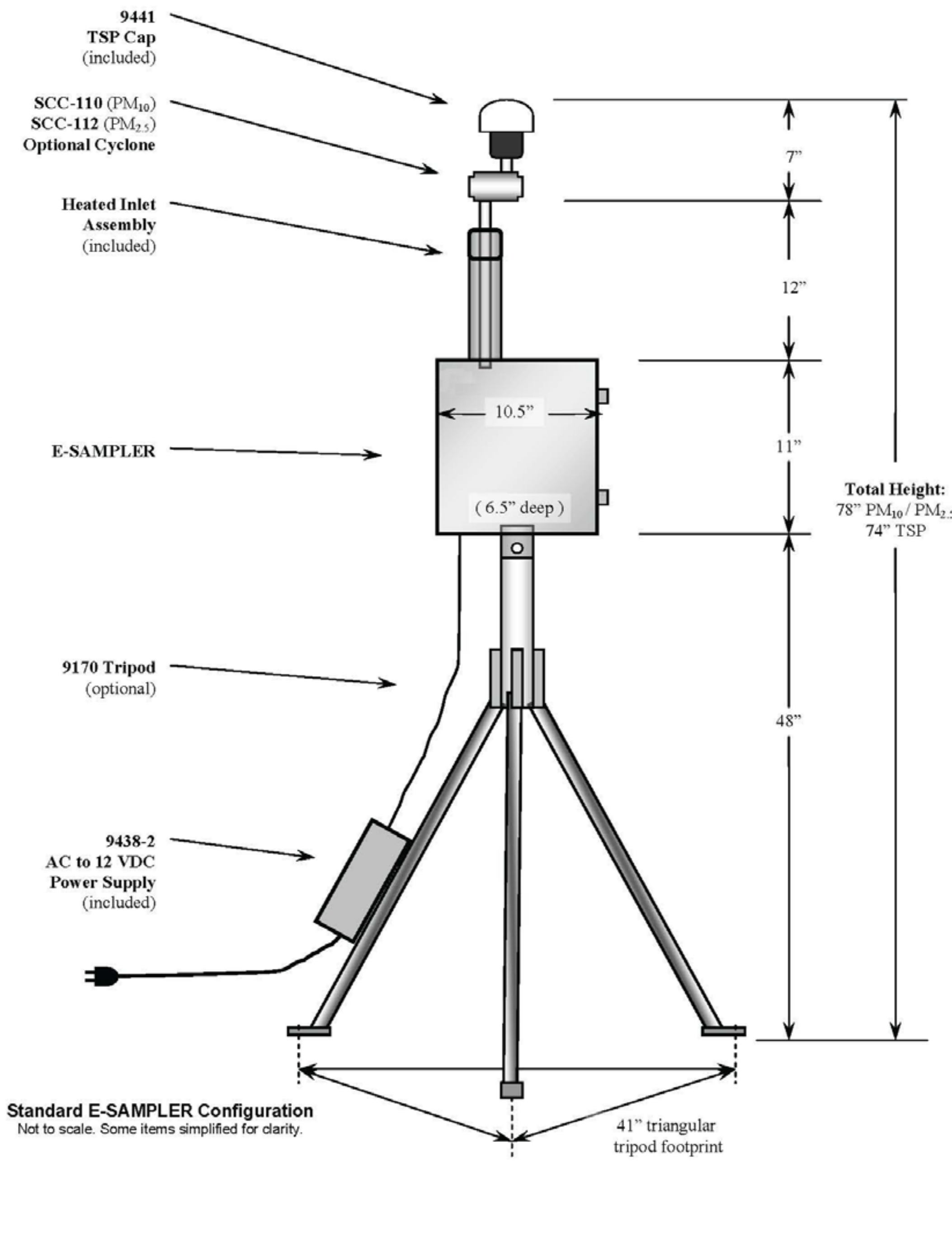
Warning: Avoid contact of jewelry with electrical circuits. Remove rings, watches, bracelets and necklaces to prevent shorting and electrical burns.

Warning: Do not operate the sampler if any of the parts are defective, damaged, or missing.

Warning: Be aware of weather patterns; leave the sampler area if storms approach.

Warning: Ensure that the sampler is securely mounted to its tripod and a safe distance from heavy equipment.

Figure B.1-2:
E-Sampler System Schematic



B.2 SELECTION, ACCEPTANCE, CONFIGURATION AND INSTALLATION

B.2.1 Selection

The Met One E-Sampler is a particulate sampler that has been shown to provide measurements comparable to those from federal reference and equivalent methods when an appropriate correction factor derived from a gravimetric filter test is employed. Rationale for its selection is provided in Section 4.6 of the DCAQMP.

A complete listing of accessories, consumables and replacement / spares is given in Section 10 of Reference 2.

B.2.2 Acceptance

1. Upon receipt of the instrument, inspect for any apparent shipment damage.

2. Remove any packing material from around and inside the instrument.

3. Compare the delivered equipment with the manufacturer's packing slip.

4. Check inside for any broken components:
   a) If damage is apparent, make arrangements to return the instrument to the shipper;
   b) If no damage is evident, proceed with instrument setup.

B.2.3 E-Sampler User Interface Summary

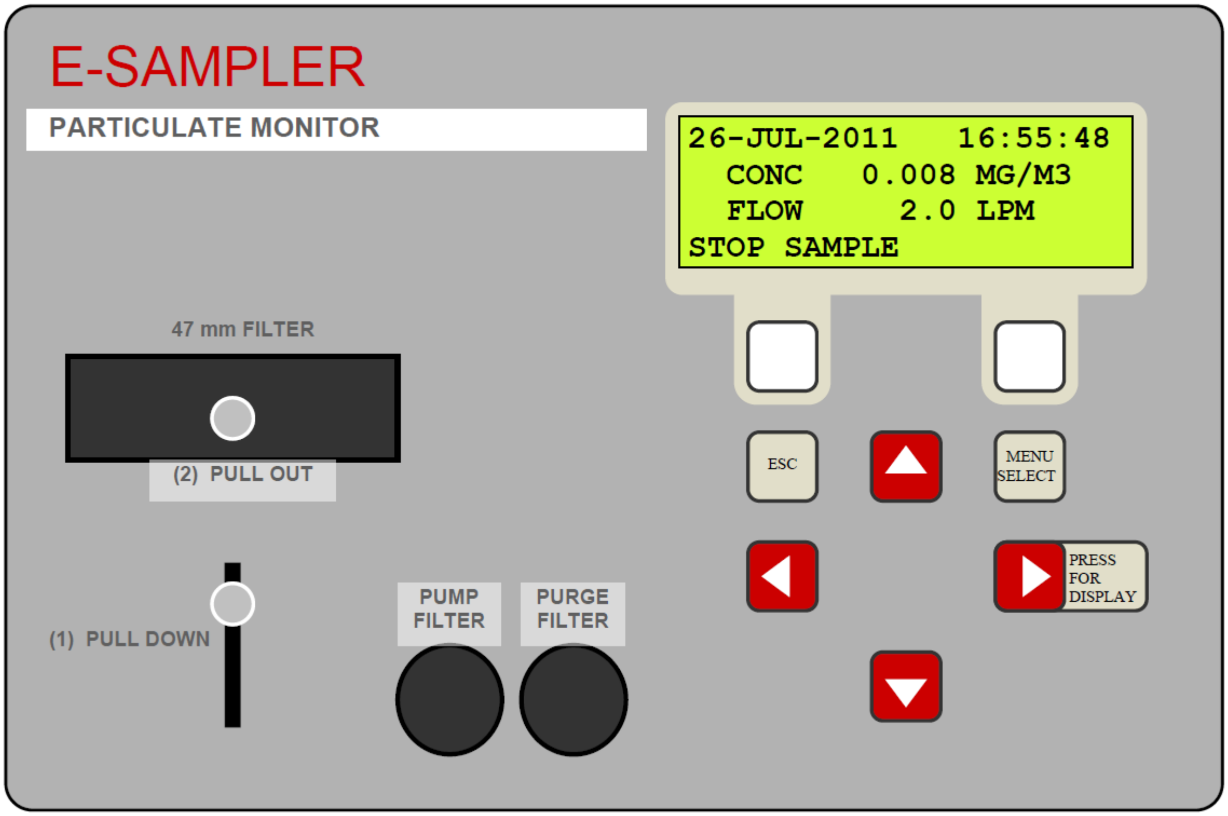
The E-Sampler user interface consists of a 4x20 character liquid crystal display (LCD) and a dynamic keypad. The two white keys under the display are called "soft keys." These are dynamic keys which change in response to a menu option displayed directly above the key on the bottom row of the display. The functions of these keys depend on which menu is shown on the display, and are often used for functions such as "SAVE" and "EXIT."

The four red arrow (cursor) keys are used to scroll up, down, left, and right, to navigate in the menu system, and to select items or change fields on the screen. The arrow keys are also often used to change parameters or increment/decrement values in the menu system. The right arrow key can be used to wake up the display if it has turned off to save power.

The MENU/SELECT key is used to enter the main menu or to select an item in a list. The ESC key is used to escape or exit out of a menu.

These functions are shown graphically in Figure B.2-1 and summarized in Table B.2-1.

Figure B.2-1: E-Sampler Front Panel



E-Sampler User Interface and Front Panel

Table B.2-1: Summary of E-Sampler Keypad Functions	
KEY	**Description**
Soft Key Left	Command is displayed on the bottom left portion of the screen.
Soft Key Right	Command is displayed on the bottom right portion of the screen.
ESC	Cancels operation. Move back one screen.
MENU/SELECT	Selects highlighted section. Brings up MAIN MENU.
▲	Move up, index up, or increase value.
◀	Move or index left.
▼	Move down, index down, or decrease value.
▶	Move or index right.

B.2.4 E-Sampler Configuration - Introduction

This section describes the process for setting up and configuring the E-Sampler, as well as the basic steps required to put the unit into operation. Some of the topics in this section will reference sections of the operating manual for more detailed information.

Whenever possible, it is best to bench test the unit (prior to deployment) in a controlled, sheltered environment to ensure the unit works properly, and to become familiar with its functions. Any apparent problems with the instrument can be more easily resolved in an office or lab environment. Then, the person installing the instrument in the field will have some assurance that the instrument works properly at the outset.

The sampler's setup configurations can also be programmed at this time; the sampler includes a non-volatile memory that will retain the configuration values when the sampler is powered down and disassembled for transport to the field. Physical installation of the E-Sampler in the field is addressed in Section B.3 of this SOP.

The steps for initial startup and programming of the E-Sampler are described in Sections B.2.5 and B.2.6, including:

1. Power on and start the unit,
2. Set the real-time clock, and
3. Configure the remaining setup parameters.

Note that items 2 and 3 are normally executed during the instrument startup procedure, but can also be done from the main menu while the sampler is operating.

B.2.5 Power On and Start the Unit

1. As soon as power is applied to the E-Sampler, the unit will boot up and display the ABOUT screen showing the firmware revision for a few seconds. The ABOUT screen can also be viewed through the menu system.

2. The E-Sampler will then default to the OPERATE screen as shown below. The START SAMPLE key (left white key) must be pressed to start the unit running. A confirmation screen will appear; press the YES key. The E-Sampler will begin by running a SELF-TEST process for about three minutes, where the optical zero and span functions will be checked.

3. After the SELF-TEST process, the E-Sampler is running and ready to use, if set to CONTINUOUS sampling mode. The date, time, real-time concentration, flow rate, and sampling condition are displayed.

```
26-JUL-2011  15:49:06
  CONC: UNIT OFF
  FLOW:     0.0 LPM
START SAMPLE
```

```
26-JUL-2011  15:49:06
SELF-TEST RUNNING

STOP SAMPLE
```

```
26-JUL-2011  15:49:06
  CONC: 0.008 MG/M3
  FLOW:     2.0 LPM
STOP SAMPLE
```

4. Pressing the ▼ down arrow displays the other current sensor readings for ambient temperature (AT), barometric pressure (BP), relative humidity (RH), and battery voltage. Note that the display also includes placeholders for wind speed (WS) and wind direction (WD), but the E-Samplers at the Midnite Mine site will not include those optional sensors (those parameters will be collected by a separate meteorological station as shown in Figure B.1-1). Pressing the ◄ left arrow key will scroll back through historical logged data. You may press ESC at any time to immediately return to the current concentration screen from any historical data screen. The MENU/SELECT key may be pressed at any time to enter the main menu screen. This screen is the top of a tree style menu system. Use the arrow keys to highlight an entry and press MENU/SELECT again to select that entry. Pressing ESC will back up along the tree to the top. See Section 4 of the Operating Manual for details about how to navigate the E-Sampler user interface and menu system.

B.2.6 Set Clock and Configure Sampler Parameters

The SETUP menu is located in the main E-Sampler menu. Use the arrow keys to select SETUP option in the main menu, then press the MENU/SELECT key to enter the menu. Use the ▲▼ keys to select the desired sub-menu and press the SELECT key again to enter. Note that settings are stored in non-volatile memory and will not be lost if the unit is powered down. The top SETUP menu is shown below:

```
 CLOCK
 AVERAGE PERIOD
 CONCENTRATION
▼SAMPLING MODE
 ALARM CONTACT
 RH HEATER CONTROL
 SELF-TEST
 COMMUNICATIONS
 STATION ID
■ENGINEERING UNITS
```

1. The SETUP > CLOCK menu is used to change the date or time. The current date/time is shown at the top of the screen. Use the arrow keys to change the bottom values, then press SET. The menu will exit automatically. Press EXIT to leave the screen without changes.

```
27-JUL-2011   16:36:42
27▼JUL-2011   16:36:42

SET               EXIT
```

2. The SETUP > AVERAGE PERIOD screen is used to change the averaging period and data logging interval for the concentration measurements and all of the other sensor parameters logged by the E-Sampler. At the Midnite Mine an averaging period of 5 minutes will be used. If necessary modify the setting with the ▲▼ keys and press SAVE. Press EXIT to go back to the setup menu without making changes.

```
AVG PERIOD:▼ 1 MIN

SAVE              EXIT
```

3. The SETUP > CONCENTRATION screen is used to set the scaling of the concentration measurements. Use the ◄► keys to select the desired value, and the ▼ key to change the value. Press SAVE to save the changes or EXIT to leave without changes. The **RANGE** setting sets the full-scale range of the E-Sampler analog output; it is normally set to 10 mg/m^3, but is unimportant for the Midnite Mine E-Samplers because the analog output signal is not used for data transmission. The **CONC UNITS** setting establishes whether the concentration values are stored in memory in units of milligrams per cubic meter (mg/m^3) or micrograms per cubic meter (µg/m^3); units of mg/m^3 are used at the Midnite Mine. The **K-FACTOR** setting is the user-set slope correction multiplier which is applied to all concentration measurements. This is used to correct the E-Sampler concentration readings to compensate for mass errors caused by variations in the characteristics of the local particulate. The manufacturer default value of 1.000 is commonly used unless a gravimetric filter test has been performed as described in Section B.4 of this SOP. However, past results at the FMC OU indicate that an estimated factor of 3.000 should be used to obtain reasonable data until an initial filter test is performed.

```
   RANGE:▼0-10   MG/M3
CONC UNITS:▼MG/M3
 K-FACTOR: 01.000
SAVE              EXIT
```

4. The SETUP > SAMPLING MODE screen is used to set the E-Sampler for either CONTINUOUS (default) or TIMED sampling operation. At the Midnite Mine the CONTINUOUS mode will always be used. If necessary use the arrow keys and SAVE key to select the CONTINUOUS mode.

```
SAMPLING
    MODE:▼TIMED

SAVE                  EXIT
```

5. The SETUP > ALARM CONTACT screen is used to establish the rules for activating the alarm contact closure relay output of the E-SAMPLER. This setting is not applicable to the Midnite Mine program, because alarms will be triggered based on calculations performed at the base station, and not by the E-Samplers themselves.

6. The SETUP > RH HEATER CONTROL screen is used to set how the inlet heater is used to control the RH of the sample air stream. Use the arrow keys to edit the value, then press SAVE. INTERNAL RH is the current reading from the sample RH sensor located in the 47 mm filter holder station. RH SETPOINT is the threshold at which the E-Sampler turns on the inlet heater to limit the RH of the sample air. This can be set from 0 to 100%. When the sample RH exceeds this setpoint, the inlet heater turns on to drive down the humidity through mild 10 watt heating. When the RH drops 1% below the setpoint, the heater turns off. The default setting is 50%, but a setting of 35% will be used at the Midnite Mine. This setting results in some increase in power consumption (the inlet heater accounts for the majority of the E-Sampler's power consumption).

```
INTERNAL RH:   44 %
RH SETPOINT:  050 %

SAVE                 EXIT
```

7. The SETUP > SELF-TEST screen is used to set the interval at which the E-Sampler will perform the automatic zero and span tests to verify the optical system. The PERIOD can be set to 15 minutes, 1 hour, 2 hours, 12 hours, or 24 hours. The self-test takes up to three minutes. The zero test circulates clean filtered air through the optical system to establish a baseline signal. The span test feeds a small amount of laser light from the light trap back into the detector to check the detector response. For the Midnite Mine network a SELF-TEST interval of 1 hour will be used for normal operation. However, a SELF-TEST interval of 15 minutes will be used for the ~12 hours immediately preceding a filter test.

```
SELF-TEST
PERIOD:▼ 1 HR

SAVE                 EXIT
```

8. The SETUP>COMMUNICATION screen is used to set the analog voltage and serial port baud rate. Because no analog outputs are being used at the Midnite Mine, the only relevant setting is the BAUD RATE, which sets the speed at which data are transmitted from the E-Sampler's RS-232 serial port to the adjacent radio that in turn transmits data to the base station. It is set at the default value of 9600 as shown on the screen below.

```
DAC RANGE:▼1.0  VOLT
BAUD RATE:▼9600

SAVE             EXIT
```

B.2.7 E-Sampler Siting

Although the E-Sampler is not a reference or equivalent method, appropriate siting criteria should be observed as much as possible. On occasion (at the Midnite Mine site) the primary objective of monitoring fugitive dust impacts from construction activities may require less-than-ideal siting. The manufacturer's siting recommendations are found in Section 3.1 of the Operator's Manual. The E-Sampler unit is designed to be weatherproof and water resistant, but should be mounted on a level, sturdy, vibration-free structure. At the Midnite Mine the monitors will be mounted on tripods that are normally placed on the ground and secured with heavy rocks and/or stakes. Important criteria that should normally be followed at the Midnite Mine include the following:

1. The sampler must be located to allow unobstructed air flow for a minimum of 1 meter in all directions.

2. Place the sampler inlet at a height of approximately 2 meters above ground level (mounting the sampler on the supplied ground-based tripod will position the inlet at approximately 2 meters above ground, which is within the normal human breathing zone).

3. Place the sampler inlet at least 2 meters from any other particulate matter samplers at the site.

4. Place the sampler inlet at least two meters from obstructions such as short walls, fences, etc.
5. Place the sampler inlet at least 20 meters from the drip line of any overhanging trees (***this may not always be feasible at the Midnite Mine***).

6. There must be a 270 degree arc of unrestricted airflow around the inlet. The predominant direction of particulate movement during the highest concentration season must be included in the 270 degree arc (***this may not always be feasible at the Midnite Mine***).

7. If the sampler will be solar-powered, ensure that the location is exposed to the sun during daylight hours.

8. Ensure easy access to the sampler during maintenance procedures.

9. Protect the sampler from damage if it should topple over (this should be prevented by securing the tripod with stakes and/or heavy rocks).

10. The inlet must be located as far away as possible from any artificial sources of particulate, such as blowers, vents, or air conditioners on a rooftop.

11. Keep the sampler in an upright position.

As noted in the DCAQMP the purpose of the E-Sampler monitoring is to evaluate airborne fugitive dust concentrations during construction activities; therefore, the roving samplers will normally be placed in close proximity to, and downwind from, specific construction areas. However, this does not mean that the monitors should be placed 20 feet from an excavator! Such siting is not representative of dust exposure to on-site personnel, and would guarantee frequent or constant TSP alarms. In general, the monitors should be placed at a distance of 50 to 100 yards from construction activities or heavily traveled roads.

B.2.8 Mount and Assemble the E-Sampler, Radio and Antenna

The E-Samplers, radios and antennas will be mounted on tripods by Bison Engineering prior to the start of construction activities. Experience at FMC has shown that E-Samplers occasionally fail and require replacement with spares; this is a simple like-for-like mechanical procedure that is not repeated here. Please consult Section 2.2 of the Operating Manual (under “Tripod Mounting”) if additional detail is needed. ***Note: If a spare E-Sampler is installed, it must be correctly configured prior to use as described in Sections B.2.4. through B.2.6 of this SOP.***

The radios have proven extremely reliable, but their replacement is less straightforward due to system programming changes that may be required. In that event, consultation with Bison Engineering and possibly Met One will be required.

B.2.9 Transport the E-Sampler to the Monitoring Location

The three roving samplers that may be in use at any given time will be relocated frequently as construction activities progress – sometimes on a daily basis. The sampler, tripod, radio and antenna will normally be transported as a single assembled unit; an entire E-Sampler, tripod, radio and antenna assembly weighs approximately 40 pounds. They are most easily transported in an uncovered pickup truck. Normally two units can be transported at once if they are carefully positioned.

Once at the desired location, connecting the E-Sampler power cable to a deep-cycle 12-volt battery will automatically power up both the monitor and the radio. Normally, an E-Sampler will operate for six 12-hour daytime shifts before the battery requires recharging. Depending on siting and logistical considerations, one or more of the fixed samplers may employ a solar-powered battery charging system – thereby eliminating the need to recharge those batteries.

B.3 CALIBRATIONS

B.3.1 Frequency

Calibration checks of each operating E-Sampler will be performed by Bison Engineering once per calendar month in which construction is occurring. In any given calendar quarter, no more than two of the monthly checks will be performed 1) by the same person or 2) using the same set of calibration standards. This will provide a quarterly independent verification (audit) of calibration procedures and standards.

B.3.2 Scope

Monthly calibration checks and adjustments (if needed) will be performed for the operating and monitoring parameters shown in Table B.3-1.

B.3.3 Equipment

To maintain independence, two sets of NIST-traceable calibration equipment must be available as discussed in Section B.3.1. Table B.3-1 lists the type of equipment needed for each monthly calibration check, and identifies where the procedure is shown in this SOP. Note that the BGI DeltaCal and BGI TetraCal units both include the necessary sensors to calibrate the E-Sampler's ambient temperature, ambient pressure and flow rate sensors. Both units must be certified annually by the manufacturer to maintain NIST-traceability.

Table B.3-1:
E-Sampler Calibration Summary

Sensor and Type of Check	Equipment / Standard	SOP Reference
Time Check	Cell phone	B.3.5
Leak Check	Rubber inlet cap	B.3.6
Ambient Temperature (AT)	BGI TetraCal temperature sensor; or BGI DeltaCal temperature sensor	B.3.7
Barometric Pressure (BP)	BGI TetraCal pressure sensor; or BGI DeltaCal pressure sensor	B.3.8
Flow Rate (FLOW)	BGI TetraCal flow rate monitor with connecting tubing; or BGI DeltaCal[1] flow rate monitor with connecting tubing	B.3.9

[1]If a DeltaCal unit is being used for flow measurements, ensure that it includes an E-Sampler flow adapter and that the DeltaCal is rated for flow measurements down to at least 1.5 liters per minute.

Equipment Cautions

Caution: Protect the TetraCal and DeltaCal units from mechanical shock to prevent damage to the pressure and flow sensors.

Caution: All measurements of the E-Sampler flow rate must be in units of actual ambient volumetric flow rate units (not mass flow rate units or flow rate at standard conditions).

Caution: Do not adjust the E-Sampler's sample flow rate if there is any doubt about the temperature or pressure systems not being in calibration. To ensure accuracy, always verify the calibration of the temperature and pressure sensors (and adjust if necessary) prior to calibrating the flow rate system.

Caution: Verify that there are no external leaks before performing a flow rate calibration.

Caution: Verify tight connections between the flow rate standard and the sampler at all seals and hose connections.

Caution: When quality assurance equipment is not in use, cap all entrance points and store in a protective case or container.

B.3.4 Documentation

Calibration results are documented on the form shown in Figure B.3-1. A blank copy of that form is provided at the end of this SOP.

B.3.5 Time Check

A time check is performed at the start of each calibration check. While the date and time displayed on the E-Sampler have no bearing on data accuracy (because the data are compiled and time-marked from the base station data logger), they should be checked and corrected once per month for the convenience of on-site personnel.

The SETUP > CLOCK menu is used to change the date or time as shown below. The current date/time is shown at the top of the screen. Use the arrow keys to change the bottom values, then press SET. The menu will exit automatically. Press EXIT to leave the screen without changes.

```
27-JUL-2011  16:36:42
27▼JUL-2011  16:36:42

SET               EXIT
```

B.3.6 Leak Check

A leak check must be performed once per month, and before any adjustments to the E-Sampler flow rate can be made. The procedure is shown below:

The CALIBRATE > LEAK TEST screen shown below is used to check for airflow system leaks which could affect the accuracy of the flow measurements, or cause unwanted measurement biases.

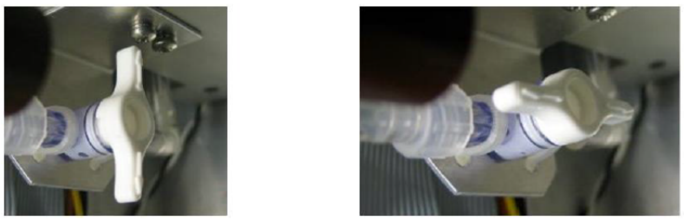
```
STEP 1
CAP OFF INLET

NEXT
```

```
STEP 2
CLOSE PURGE VALVE

NEXT
```

```
STEP 4
LEAK TEST: PASS
     FLOW:  0.0 LPM
NEXT
```



Purge valve closed (Left) and open (Right). Located inside the battery compartment

1. Remove the TSP head from the inlet. Cap off the top of the E-Sampler inlet tube with a rubber cap.

2. Open the front door and remove the battery cover plate. Locate the purge cutoff value on the left side and rotate it to the closed position as shown above.

3. Wait for the system to zero the flow sensor reading. This step is omitted if steps 1 and 2 take longer than the zero flow sensor process (~25 seconds). The software automatically proceeds to step 4 when the zero flow sensor process has completed.

4. The pump will start. Wait for the flow reading to stabilize (about 2 minutes). The leak test will be OK if the reading is 0.3 liters per minute or less. The leak test will FAIL if the reading is greater than 0.3 liters per minute. Do not run this test for more than 5 minutes because it will reduce the lifetime of the pump motor.

5. Hit NEXT to turn off the pump. Rotate the purge cutoff valve back to the open position as shown above. Remove the rubber cap from the inlet and reinstall the TSP head.

6. If the result is unsatisfactory, find and correct the source of the leak. The most common cause is failure of the 47 mm filter holder assembly to seat properly (see Figure B.2-1). Refer to Section 8.3 of the Operating Manual (under “Leak check failures”) for additional guidance.

B.3.7 Ambient Temperature Calibration

The CALIBRATE menu is located in the main E-Sampler menu. Use the arrow keys to select CALIBRATE option in the main menu, then press the MENU/SELECT key to enter the menu. Use the ▲▼ keys to select the desired sub-menu and press the SELECT key again to enter. The top CALIBRATE menu is shown below:

```
 CALIBRATE AT
 CALIBRATE BP
 CALIBRATE RH
▼CALIBRATE FLOW
 CALIBRATE DAC
■LEAK TEST
```

1. The CALIBRATE AT screen is used for field audits or calibrations of the ambient temperature measurement of the E-Sampler and is shown at the end of this procedure.

2. The E-SAM parameter is the current reading from the E-Sampler temperature sensor. The REF parameter is where you can enter the correct value from your traceable temperature standard, using the arrow keys. The E-SAM value should change to match the REF value when you press the CALIBRATE soft key.

3. The DEFAULT soft key can be pressed to clear all previous field calibrations and restore the factory calibration for the sensor. Use this if difficulty is encountered during the calibration. Press ESC to escape without changes.

4. Note: The E-Sampler ambient temperature sensor is an unshielded thermistor bead located in the bottom of the enclosure, and as such is not particularly accurate compared to solar shielded or aspirated sensors. An accuracy of ±2 degrees C is adequate for flow control purposes. During very warm, calm sunny conditions errors of as much as ±3 degrees C are not uncommon – even for a properly functioning sensor (usually the E-Sampler sensor will read ***higher*** than the reference thermometer). Some judgment is required as to whether an adjustment is warranted.

```
AMBIENT TEMPERATURE
E-SAM:  25.4 C
  REF:  24.0
CALIBRATE     DEFAULT
```

B.3.8 Ambient Pressure Calibration

The CALIBRATE BP screen shown at the end of this procedure is used for field audits or calibrations of the ambient barometric pressure measurement of the E-Sampler.

1. The E-SAM parameter is the current reading from the E-Sampler pressure sensor. The REF parameter is where you can enter the correct value from your traceable pressure standard, using the arrow keys.

2. Note that the E-Sampler readings are shown in units of Pascals (equal to millibars x 100), but the TetraCal and DeltaCal units show pressure in millimeters of mercury (mmHg). To convert mmHg values to Pascals, multiply them by 133.3.

3. If the E-Sampler reading differs from the standard value by less than 1000 Pascals no adjustment is necessary.

4. If the error is greater, enter the correct value next to REF. The E-SAM value should change to match the REF value when you press the CALIBRATE soft key.

5. Note that the DEFAULT soft key can be pressed to clear all previous field calibrations and restore the factory calibration for the sensor. Use this if difficulty is encountered during the calibration. Press ESC to escape without making changes.

```
BAROMETRIC PRESSURE
E-SAM:   97263 PA
  REF:   98000 PA
CALIBRATE     DEFAULT
```

B.3.9 Flow Sensor Calibration

The CALIBRATE FLOW screen is used for field audits or calibrations of the sample flow measurement of the E-Sampler. Remove the TSP inlet and any cyclones from the E-Sampler inlet tube, and then connect the top of the inlet tube to the outlet of your traceable flow meter using a length of appropriate flexible tubing. The E-Sampler temperature, pressure, and leak status must be checked before performing any flow calibrations in order to prevent errors. The E-Sampler flow rate should be maintained to within ±0.1 LPM (1.9 to 2.1 LPM) to enable a proper total air volume calculation when used with a 47 mm filter (i.e., for gravimetric correction factor analysis).

1. The SETPOINT parameter is the target flow rate that the E-Sampler will attempt to regulate to (refer to screen at end of this procedure).

2. The E-SAM parameter is the current reading from the E-Sampler flow sensor, in actual volumetric liters per minute. The E-Sampler should automatically regulate to the setpoint (2.0 LPM) when the flow calibration screen is entered.

3. Once steady flow is achieved, compare the E-Sampler displayed flow (2.0 LPM) against that shown by the TetraCal or DeltaCal flow standard. If the difference is no more than ±0.08 LPM (4%) no adjustment is necessary.

4. If adjustment is needed, enter the correct flow value (at actual conditions) next to the REF parameter (note that it can only be entered to the nearest 0.1 LPM). The E-SAM value should change to match the REF value when you press the CALIBRATE soft key.

5. Note that the DEFAULT soft key can be pressed to clear out all previous field calibrations and restore the factory calibration for the sensor. Use this if difficulty is encountered during the calibration. Press ESC to escape without making changes.

```
SETPOINT: 2.0 LPM
   E-SAM: 2.0 LPM
     REF: 2.0 LPM
CALIBRATE     DEFAULT
```

Figure B.3-1: Calibration Results Form

MET ONE E-SAMPLER CALIBRATION CHECKS

LOCATION: ______________________________

DATE/TIME: ______________________________ PST

SAMPLER S/N: ______________________________

RADIO NO.: ______________________________

TSP CAL FACTOR: ______________________________

SELF-TEST FREQ: ______________________________

PERFORMED BY: ______________________________

TETRA CAL S/N: __________

TIME CHECK (MST)

SAMPLER T ERROR __________ CORRECTED? __________

FLOW RATE (LPM) (Allowable error = ≤ +/- 4.0%)

SAMPLER IND. __________ TETRA CAL __________

% Difference = 100 x (Sampler Ind.- Tetra Cal)/Tetra Cal) __________ %

Pass __________ Fail__________

AMBIENT TEMP (°C) (Allowable error = ≤ +/- 2.0 °C)

SAMPLER IND. __________ TETRA CAL (Tf) __________

Difference = (Sampler Ind. - Tf) ____0____ °C

Pass __________ Fail__________

BAROMETRIC PRESSURE (mmHg) (Allowable error = ≤ +/- 1000 Pa)

SAMPLER __________ Pa

TETRA CAL __________ mmHg

TETRA CAL x 133.3= __________ Pa

Difference = (Sampler - Tetra Cal) = __________ Pa

Pass __________ Fail__________

LEAK CHECK (LPM) (Allowable = ≤ 0.2 LPM)

SAMPLER __________ LPM

Pass __________ Fail__________

COMMENTS:

FILTERS?

B.4 ESTABLISHING A K-FACTOR CORRECTION

The main limitation of most nephelometer instruments is that the accuracy of the mass output can be negatively affected by variations in size, color, shape, and index of refraction of the sampled particles. One of the most important uses for the 47 mm filter system is determination of a gravimetric K-factor (slope multiplier) to correct the E-Sampler signal to compensate for local particulate characteristics. A gravimetric K-Factor must be generated for the E-Sampler if accurate concentration measurements and good agreement with Federal Reference Methods or Federal Equivalent Methods are expected. In some applications the appropriate K-Factor will be quite significant, such as a multiplier of 3 or 4 or even more. Once determined, the K-Factor will generally remain valid for that E-Sampler and location as long as the particulate type is consistent.

This section presents a procedure for determining a gravimetric correction factor for the Midnite Mine E-Samplers; this evaluation will be conducted for each operating E-Sampler at the outset of monitoring. A filter disc is carefully weighed on a microbalance scale (resolution of 1 microgram) under laboratory conditions, then placed into the E-Sampler filter holder and run for a known period of time. The filter is then reweighed in the lab, and the resulting total mass of the dust on the filter is correlated with the volume of air sampled, and compared with the concentrations that the E-Sampler recorded over the same time period. The procedure for determining a correction factor is listed below:

1. If the data are important, download and save all E-Sampler data from the sampler's internal memory before changing the K-Factor setting! When the K-Factor value is changed, it will apply to any previous data already stored in memory. These data are typically not important for the Midnite Mine project because the E-Sampler readings are continuously averaged and reported at the base station computer (changing the K-Factor will have no effect on data that have been averaged by the base station).

2. Pre-weigh the 47 mm disc PTFE/Teflon filters on a microbalance scale according to Bison Engineering's ***Standard Operating Procedure: Gravimetric Laboratory Procedure for Air Monitoring Sample Filters***.

3. Record the filter information in the space provided on the E-Sampler Filter Test form shown in Figure B.4-1.

4. Run the E-Sampler with a 15-minute self-test interval for a period of at least 10 hours immediately before installing the filter. This ensures that the sampler's optical chamber is clean before the filter test is started.

5. Install the filter and perform the leak test procedure described in Section B.3.5. Complete the "Filter Installation Information" section of the E-Sampler Filter Test form.

6. Operate the E-Sampler in the normal manner for a period of at least 144 hours. This is equivalent to two weeks of construction activity, assuming six 12-hour work days

per week. In practice, filters will normally be installed in conjunction with a monthly calibration, and removed at the time of the following monthly calibration. A fairly long sampling period is necessary to collect a sufficient amount of particulate matter for analysis, due to the low sampling rate. The exact length of the sampling period is not important, as long as it is precisely known.

7. After the sample period has ended remove the 47 mm filter, place it in a zip-loc bag and record the “Filter Removal Information” section of the E-Sampler Filter Test Form. Replace the blank filter holder assembly in the E-Sampler, perform a leak test and resume normal monitoring.

8. Post-weigh the 47 mm disc PTFE/Teflon filters on a microbalance scale according to Bison Engineering’s ***Standard Operating Procedure: Gravimetric Laboratory Procedure for Air Monitoring Sample Filters***. The filter must be handled carefully and transported carefully in a hard container.

9. Download the 5-minute E-Sampler data from the base station and average those values for the entire sample period. Be sure to exclude any invalid data values (such as very high values caused by fog or heavy snow; in those instances, the total sampling time must be adjusted as well).

10. Evaluate the E-Sampler total flow over the sample period. The E-Sampler data does not record the sample volume, so you must calculate it. If the E-Sampler ran for 144 hours, then the nominal sample volume would be 2.0 LPM, times 60 min/hr, times 144 hours. This equals 17,280 liters or 17.28 cubic meters of nominal sample volume. However, you must also compensate for the fact that the sample stops for about 2.8 minutes each time the automatic self-test ran during the timed sample. For example, if the E-Sampler was set to hourly self-test, then 2.8 minutes of each hour would not have flow going through the 47 mm filter. This amounts to 2.0 LPM times 2.8 minutes, or 5.6 liters of air per hour. So if the sample ran for 144 hours, then 5.6 liters per hour times 144 hours equals 806 liters. The corrected total sample volume would then be 17,280 – 806 equals 16,474 liters, or 16.474 cubic meters. Note: 1 cubic meter equals 1000 cubic liters.

11. Use the change in mass results from the gravimetric filter analysis (the difference between the clean and dirty filter weight in mg) and the total sample flow volume (m^3) through the filter to calculate the concentration of particulate on the 47 mm filter in mg/m^3. The concentration is calculated as total mass divided by total sample volume. For example, if the clean filter weighed 77.643 mg and the dirty filter weighed 78.345 mg, then the total particulate mass on the filter would be 78.345 minus 77.643, or 0.702 mg. If the total sample volume was 16.474 cubic meters, then the filter total concentration would be 0.702 mg divided by 16.474 m^3, or 0.043 mg/m^3.

12. Calculate the K-Factor as the 47 mm filter total concentration divided by the E-Sampler total light scatter concentration. For example, if the filter total concentration was 0.043

mg/m^3 and the E-Sampler total concentration was 0.030 mg/m3, then the K-Factor would be 0.043 divided by 0.030 or 1.433.

13. Program the calculated K-Factor into the E-Sampler SETUP > CONCENTRATION menu. See step 3 in Section B.2.6. The E-Sampler will multiply all stored and subsequent concentration measurements by the K-Factor. The resulting corrected concentrations are stored in memory, shown on the LCD, and scaled on the analog output.

14. Two average K-factors will be calculated and used for subsequent sampling: one for the three fixed samplers located near the site perimeter, and another for the three roving samplers located near construction activity.

Data used for the above calculation are presented in Table B.4-1.

Table B.4-1: Example K-Factor Calculation Data

Parameter	Value / Calculation
E-Sampler Sample Event Time	144 hours (twelve 12-hour construction days)
E-Sampler Flow Rate	120 liters per hour (2.0 LPM)
Uncorrected E-Sampler Total Sample Flow Volume	17,280 liters (144 hours x 120 liters/hour)
E-Sampler Self-Test Interval (no flow)	Hourly (2.8 minutes per hour)
Self-Test Flow Correction	-806 liters (-5.6 liters per hour x 144 hours)
Corrected E-Sampler Total Sample Flow Volume	16,474 liters (17,280 liters– 806 liters) or 16.474 cubic meters
Clean 47 mm Filter Weight	77.643 mg
Dirty 47 mm Filter Weight	78.345 mg
47 mm Total Particulate Mass	0.702 mg
47 mm Filter Total Concentration	0.043 mg/m^3 (0.702 mg/16.474 m^3)
Average of E-Sampler Readings	0.030 mg/m^3
Calculated K-Factor	1.433 (0.043 mg/m^3/0.030 mg/m^3)

Figure B.4-1: E-Sampler Filter Test

A. FILTER INFORMATION

Filter Type___________________________

Filter Number_________________________

Cassette Number_______________________

B. FILTER INSTALLATION INFORMATION

E-Sampler Number___________________________________

Radio Number______________________________________

Location at Time of Filter Installation___________________

Installed By____

Date____

Time____

Leak Check Result after Filter Installation__________ LPM

(*must be ≤ 0.2 LPM)*

C. FILTER REMOVAL INFORMATION

E-Sampler Number___________________________________

Radio Number_______________________________________

Location at Time of Filter Removal_____________________

Removed By____

Date____

Time____

Confirm Blank Filter Holder is Reinstalled________________

Leak Check Result after Filter Holder Re-installed _________LPM

(must be ≤ 0.2 LPM)

D.COMMENTS

B.5 PREVENTIVE MAINTENANCE

Preventive maintenance is a program of positive actions aimed at preventing failure of monitoring and analytical systems. The overall objective of a routine preventive maintenance program is to increase measurement system reliability and to provide for more complete data acquisition.

B.5.1 Routine Maintenance Activities

The E-Sampler is a very low-maintenance instrument compared to many particulate monitors. The recommended routine maintenance activities for the E-Sampler are presented in Table B.5-1. Detailed instructions for the maintenance activities listed are available in the indicated sections of this SOP and/or the E-Sampler Operator's Manual, as indicated.

Section 8.5 of the Operator's Manual shows the pump replacement procedure, which should be consulted in the case of unexpected pump failure. However, it is probably most efficient to have routine pump replacement performed by the manufacturer in conjunction with factory servicing.

Table B.5-1: E-Sampler Preventive Maintenance Schedule

Maintenance Item	Suggested Frequency	Reference
Recharge E-Sampler 12-volt batteries	Weekly	
System leak check	Monthly	SOP Section B.3.6
Flow, temperature and pressure audit/ calibration	Monthly	SOP Sections B.3.7 – B.3.9
Check / clean TSP inlet	Monthly	Manual Section 8.7
Check digital alarm log	Monthly	Manual Section 8.1
Check / clean 47 mm filter holder screen	Monthly	Manual Section 8.4
Run 15-minute self-test frequency for overnight period (to clean optical chamber)	Quarterly[1]	SOP Section B.4
Replace PUMP filter and PURGE filter	6-12 Months[2]	Manual Section 8.6
Factory service, recalibration, optical system cleaning and sample pump replacement[3].	2 Years	Manual Section 8.8 Manual Section 8.5 for pump replacement
Replace lithium backup battery	5 Years	Manual Section 8.4

[1]Normally performed in conjunction with K-Factor Test.
[2]These filters ensure that air going to the sample pump and optical filter is clean, and may need to be replaced at 6-month intervals in heavy dust environments.
[3]Sample pump is rated for 10,000 hours of operation, equivalent to approximately 140 weeks of construction activity based on six twelve-hour days per week. This assumes no sampling occurs at night.

B.6 ROUTINE OPERATIONS

Field operation procedures for the E-Sampler include the following activities:

- Identify appropriate sampling locations for the roving E-Samplers.
- Transport roving E-Samplers to appropriate sites and initiate data collection for all samplers.
- Confirm that all samplers are operating properly.
- Notify on-site personnel of sampling locations via e-mail.
- Shut off samplers at the end of the workday.

Each activity is described in the following sections. Alarm notification and evaluation procedures are presented in Section B.7 of this SOP.

B.6.1 Identify Appropriate Sampling Locations

E-Sampler data collection should be initiated early in the morning, prior to the start of any construction activities. Therefore, locations of the roving samplers should be established by the end of the preceding construction day. In general the roving samplers will be placed approximately 50 to 100 yards downwind from the most significant anticipated construction activity. Some adjustment of this criterion may be necessary to maintain reasonable line-of-sight communication between each E-Sampler and the base station. Additionally, the E-Samplers need to be placed in locations where they can be safely accessed by the Field Engineer and other support personnel; i.e., they should be placed a safe distance from any heavy equipment traffic.

The Field Engineer responsible for placement must maintain close communication with the Construction Manager so that the samplers are placed in appropriate locations. It may be necessary to relocate the samplers during the day in the event that there is a significant change in the nature or location of remedial action activities.

B.6.2 Transport Samplers to Appropriate Sites and Initiate Data Collection

The roving E-Samplers will be transported to the identified monitoring locations in the back of an open-bed pickup. As each sampler is delivered its tripod should be secured with heavy rocks and/or grounding pins to prevent tipping over in high winds. (Note that the tripods for the fixed samplers can be secured with a more permanent mounting system). Next the E-Sampler power cable is connected to a 12-volt deep-discharge battery (Group 27 size). Initiate sampling as follows:

1. As soon as power is applied to the E-Sampler, the unit will boot up and display the ABOUT screen showing the firmware revision for a few seconds. The ABOUT screen can also be viewed through the menu system.

2. The E-Sampler will then default to the OPERATE screen as shown below. The START SAMPLE key (left white key) must be pressed to start the unit running. A confirmation screen will appear; press the YES key. The E-Sampler will begin by running a SELF-TEST process for about three minutes, where the optical zero and span functions will be checked.

3. If a new sampling location is being used, record its GPS coordinates and the estimated distance and direction from the closest construction activities.

4. Because time is often limited during setup, it is not necessary to wait for the SELF-TEST function to be completed as the E-Sampler will automatically begin data collection and transmission. Travel to the next site and begin operation in the same manner. The fixed E-Samplers must be started in the same manner at the beginning of each sampling day. The order of startup among the samplers is not important and should be done so as to minimize the total time required to make the network operational.

```
26-JUL-2011  15:49:06
  CONC: UNIT OFF
  FLOW:    0.0 LPM
START SAMPLE
```

```
26-JUL-2011  15:49:06
SELF-TEST RUNNING

STOP SAMPLE
```

```
26-JUL-2011  15:49:06
  CONC: 0.008 MG/M3
  FLOW:    2.0 LPM
STOP SAMPLE
```

B.6.3 Confirm that All Samplers are Operating Properly

Approximately 10 minutes after the last sampler has been started, review the E-Sampler data screen at the base station (this can also be done remotely over the internet) and ensure that each sampler is working properly:

1. The indicated flow rate should be 2.0 liters per minute for each sampler.

2. The samplers should be showing comparable temperature readings (normally they will be within ±3°C of each other).

3. The barometric pressure readings may vary among the samplers because of large elevation differences at the site. As a rule, 1) all samplers should show pressure readings between 85,000 and 95,000 Pascals and 2) the sampler at the highest elevation should show the lowest pressure reading – and vice versa.

4. The internal relative humidity sensor readings should be similar among the samplers (within ±10% of each other), and normally at or below 35% after a warmup period.

B.6.4 Send E-mail Notification of Sampler Placement

Send an e-mail to the appropriate on-site and Bison Engineering personnel identifying the sampler locations for the day. Information should include:

1. Each sampler's GPS coordinates.
2. A descriptive location: e.g., "E-Sampler No. 4 placed on the southwest corner of Remediation Area R-1."
3. Also note any unusual meteorological conditions that could affect readings, such as fog and snow (which can produce false high readings), high winds or smoke.

B.6.5 Shut Off Samplers at the End of the Day

After construction activities have ended, shut off each sampler by pressing the STOP SAMPLE soft key on the E-Sampler display. The sampler should immediately stop operating and go to its standby mode.

B.7 ALARM CALCULATION / NOTIFICATION PROCEDURE

A primary purpose of the E-Sampler monitoring network is to alert on-site personnel and regulators to ambient TSP concentrations greater than 260 µg/m^3, possibly initiating enhanced dust control measures (and in extreme cases, temporary suspension of construction) depending on the reason for the alarm.

B.7.1 Data Collection and Alarm Calculation Methodology

Some knowledge of the data collection process is necessary to understand how alarms are triggered. Each E-Sampler measures ambient conditions once every second and uses those readings to compile 5-minute averages that are stored in the sampler's internal memory. Those readings are sent to the base station and appear on its E-Sampler Conditions screen; values shown include:

- TSP average (converted to micrograms per cubic meter)
- Ambient temperature (°F)
- Ambient pressure (Pascals)
- Internal relative humidity (%; indicates how well the sampler's dryer is working)
- Sampler flow rate (LPM)
- Battery voltage

******However, those data are not stored in final memory and are not used to trigger alarms.******

In addition to the data described above, each E-Sampler transmits instantaneous TSP concentration values to the base station once per minute. The base station datalogger then uses those one-minute values to calculate and store 5-minute and 60-minute block TSP averages.

At the same time, the data logger calculates a ***rolling*** 60-minute average based on the past twelve 5-minute block averages. The rolling 60-minute average is updated every 5 minutes when a new 5-minute block average becomes available. The 60-minute block average is only updated once per hour, on the hour. For each E-Sampler the base station computer displays the latest 5-minute block average, the latest 60-minute block average and the latest 60-minute rolling average. Additionally, an alarm is shown whenever the 60-minute rolling average reaches a value of 260 µg/m^3. The alarm does not clear until the 60-minute rolling average drops below 260 µg/m^3. The TSP Alarm Conditions screen shows the latest 5-minute block, 60-minute block and 60-minute rolling averages.

Table B.7-1 illustrates how the calculation and alarm generation process works. The time period during which an alarm condition would be displayed is bolded (as well as the 60-minute rolling averages greater than 260 µg/m$^{3)}$. This example illustrates that the rolling average can capture a high one-hour TSP concentrations that the one-hour block average fails to show. In this example an alarm condition begins at 1010 when the TSP rolling average reaches 278 µg/m^3, and continues until 1055 when the TSP rolling average drops to 256 µg/m^3. In that same example, the TSP block average never exceeds 236 µg/m^3. Note that the 60-minute block average and 60-minute rolling average are identical at the top of each hour since they are based on the same twelve 5-minute block averages.

Table B.7-1: Example of TSP Calculation Methodology

Time	5-Minute Block Average	60-Minute Block Average	60-Minute Rolling Average
0905	18		
0910	25		
0915	55		
0920	135		
0925	268		
0930	355		
0935	342		
0940	299		
0945	255		
0950	277		
0955	309		
1000	328	222	222
1005	345	222	249
1010	367	222	**278**
1015	356	222	**303**
1020	302	222	**317**
1025	277	222	**318**
1030	246	222	**309**
1035	231	222	**299**
1040	206	222	**292**
1045	155	222	**283**
1050	135	222	**271**
1055	122	222	256
1100	95	236	236
1105	72	236	214
1110	65	236	189
1115	50	236	163
1120	35	236	141
1125	24	236	120
1130	25	236	101
1135	27	236	84
1140	18	236	69
1145	24	236	58
1150	26	236	49
1155	28	236	41
1200	24	35	35

B.7.2 TSP Alarm Notification Procedure

Whenever an alarm condition occurs, two things happen immediately:

1. The datalogger appends its Alarm data file to record the rolling 60-minute TSP concentration from each sampler (including all samplers, not only those experiencing an alarm condition), and the meteorological conditions including wind speed, wind direction, temperature, humidity, solar radiation and daily total precipitation. (Note that the data logger does not record the ***rolling*** 60-minute TSP data as a matter of course, only when one or more of the samplers is in an Alarm condition); and

2. An automated e-mail Alarm notification is sent to all persons on the notification tree (one per alarming sampler); the message states the concentration from the alarming sampler and the time the alarm occurred.

The Field Engineer in charge of on-site air monitoring is notified remotely via handheld device and documents the following information as shown on Figure B.7-1:

1. Note the time at which the alarm notification was initially received.

2. Record the current TSP readings for each of the alarming E-Samplers (Section A).

3. Record the current meteorological conditions (Section B), and note particularly if fog, precipitation or strong winds are present.

4. Travel to the alarming sampler location(s) and take video clips and/or photos if appropriate. Describe any on-site activities in the vicinity of the alarming samplers (Section C).

5. Based on the TSP readings, meteorological conditions and on-site activities, determine whether the alarm condition is due on-site activities, other factors, or a combination of both (Section D). Common off-site factors resulting in elevated TSP readings include:

    a. Fog or heavy snow, which can cause false elevated TSP readings. Normally such events will affect several samplers, not only one. In these cases corrective action is normally not required.

    b. Smoke from local or regional wildfires can also cause elevated readings and will normally affect all of the samplers.

    c. Strong winds, which may cause windblown dust independent from construction activities.

   d. Conversely, high TSP readings due solely to construction tend to be localized, often affecting only a single sampler located immediately downwind from a significant construction activity such as excavation or loading. However, high TSP readings may also result from a combination of construction activity and the conditions noted under b and c. Meteorological data can be invaluable to this evaluation, since they indicate whether a sampler is truly downwind from construction at the time of an alarm, or whether the alarm is partially or entirely due to adverse weather conditions.

6. Describe actions requested of the Construction Contractor, and when they were completed (Section E). This could include enhanced dust control (e.g. watering), or modification of activities.

7. During this process, document the time of alarm notifications as outlined in Section F.

8. After the corrective actions are completed, record the current E-Sampler TSP readings in the spaces shown (Section G).

9. Evaluate the effectiveness of the corrective actions (Section H). E.g. did TSP concentrations decrease to acceptable levels as a result?

10. Finally make any other comments or observations in Section I. It is especially important to note whether the TSP alarms were partially or wholly caused by off-site or regional conditions.

    a. In the case of fog or heavy snow there is usually no reason to take corrective actions or to modify operations.

    b. If the alarm is due to high winds (and not site activities per se) it may be necessary to temporarily curtail or halt operations, since airborne particulates from excavation and other activities can be exacerbated during those conditions.

Figure B.7-1: Midnite Mine TSP Alarm Record

Date:_______________ **Alarm Start Time:**____________

Prepared By:___________________ **Organization:**_______________________

A. TSP Readings for Alarming E-Samplers, ppb (enter N/A if sampler not alarming)

ES-1	ES-2	ES-3	ES-4	ES-5	ES-6	ES-7	ES-8

B. Meteorological Conditions at Time of Alarm

Wind Speed (mph)	Wind Dir. (degrees)	Temperature (°F)	Relative Humidity (%)	Solar Radiation (W/m^2)	Daily Precipitation (inches)

Was fog present?_______________ **Was precipitation occurring?**________________

C. Describe Activity in Vicinity of Alarming Sampler(s) and Identify Remediation Area. Note Whether Site was Visited, and if Photos and/or Video Clips were Taken.

____

____

____

____

D. Indicate Alarm Causes Below as Appropriate (Check Box)

On-Site Activities	Weather Conditions	Off-Site Activity	Regional Source

E. Describe Actions Requested of Construction Contractor, and Time Completed.

____

____

____

____

Figure B.7-1: Midnite Mine TSP Alarm Record (continued)

F. Record of Alarm Notifications (Should be Made in Order Shown)

Name	Organization / Title	Telephone Number	Time Notified
	Construction QA Officer		
	Construction Contractor		
	DMA / Newmont Site Manager		
	WME Supervising Contractor		
	EPA Project Manager		

G. TSP Readings Following Actions, ppb (enter N/A if sampler was not alarming)

ES-1	ES-2	ES-3	ES-4	ES-5	ES-6	ES-7	ES-8

H. Evaluate Effectiveness of Response Actions (if not effective, state why)

____

____

____

I. Other Comments / Observations

____

____

____

____

____

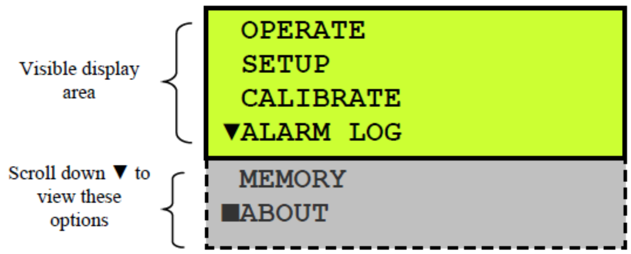
____

____

____

B.8 TROUBLESHOOTING

Problems with an E-Sampler's operation will normally be indicated by its internal Alarm log, which is a data file showing chronologically ordered occurrences of alarm conditions. It can be accessed from the Main menu as shown below:



The Main E-Sampler menu

Section 8.1 of the Operating Manual contains an extensive list of possible alarm conditions that are not repeated in full here. However, Table B.8-1 summarizes the most common alarm conditions and appropriate responses based on past experience. Additionally, the E-Sampler Conditions screen on the base station computer indicates when an E-Sampler has gone into some type of alarm condition, although it does not address all types of alarms. Note that the alarms under discussion here pertain to problems with sampler function, and are completely separate from the TSP concentration alarms discussed in Section B.7 of this SOP.

Some E-Sampler problems will not be shown by alarm codes. The most common is false high TSP readings caused by fog or heavy wet snow. These conditions will often be reflected by the site meteorological data, which will show very high relative humidity and very low solar radiation (an exception would be when the meteorological station is above a low-lying fog layer that is only affecting a particular sampler). Fundamentally these false readings are caused by condensing moisture reaching the optical chamber, which in turn is caused by insufficient drying of the sample air by the inlet heater (the heater's power rating is only 10 watts). Often, insufficient drying will be reflected by the E-Sampler's internal relative humidity reading. The internal humidity control is set at 35%, but during these conditions a reading of 50% or higher may occur. Note that when the E-Samplers are first started in the early morning a high internal relative humidity reading is not unusual, since the heater takes a few minutes to warm up sufficiently to dry the incoming sample air.

Table B.8-1: Summary of Common E-Sampler Alarms

Alarm / Error Message	Alarm Description and Appropriate Action
POWER OUTAGE	This alarm message indicates that the E-Sampler power was cycled off and then back on while the sampler was operating. This alarm message will not occur if the sampler is shut down before disconnecting power. Normally this requires no further action, unless the problem is caused by a bad power connection.
FLOW FAILED	This alarm indicates that the sampler flow rate was more than 5% out from its 2.0 LPM target flow rate for more than 5 minutes. This may indicate a failing sample pump, or a failing ambient temperature or pressure sensor. Uncommon.
BATTERY WARNING OR BATTERY FAILED	These warnings indicate a deteriorating or failed 12-volt battery. The BATTERY WARNING occurs if the input voltage drops below 11.2 volts and clears when the voltage restores to above 11.7 volts. BATTERY FAILED occurs if the voltage drops below 10.5 volts and clears when the voltage restores to above 11.7 volts. The time and date of the error will be displayed, along with the actual voltage.
DETECTOR ERROR	This alarm indicates a problem with the sampler's photodiode detector. It is possible for this alarm to occur once for no apparent reason, and then not recur for weeks or months. However, repeated occurrences require the sampler to be sent to Met One for servicing.
SOLENOID ERROR	This error indicates failure of the shutter span solenoid to open during the self-test. Occasionally the solenoid may stick during very cold weather, and it does not necessarily affect the TSP measurements. However, the solenoid should be replaced if the problem occurs repeatedly (especially during moderate temperatures).
ZERO CALIBRATE ERROR	This indicates a significant zero error during the SELF-TEST routine, and may result in false high TSP readings during E-Sampler operation. If this occurs repeatedly the sampler should be sent to Met One for servicing.

B.9 METEOROLOGICAL STATION

The Midnite Mine ambient monitoring network includes a solar-powered meteorological station, with wind, temperature, relative humidity and solar radiation sensors mounted atop a portable 10-foot tripod, plus a tipping bucket rain gauge at ground level. The instruments will be checked/calibrated at the time of installation, and a minimum of once per calendar quarter thereafter. Calibrations in successive quarters will be performed by different people using different traceable calibration standards. Table B.9-1 summarizes the meteorological instrumentation that will be used at the Midnite Mine site.

The meteorological data are not being collected to satisfy regulatory requirements, but are invaluable for evaluating the E-Samplers' TSP data - and particularly the validity of high TSP readings (as noted in Section B.1.3 of this SOP, dense fog and/or heavy snow can cause false high readings). Also, the wind data can be used to determine probable source areas during high TSP episodes.

Table B.9-1: Summary of Midnite Mine Meteorological Instrumentation

Instrument	Parameter and Range[1]	Calibration Methodology
Met One Model 034B	Wind direction, 0 to 360°	• Linearity fixture • Solar / GPS orientation check
Met One Model 034B	Wind speed, 0 to 100 mph	• Synchronous motor tests (300 & 600 rpm)
Met One Model 083-1-35	Temperature, -58 to 122°F	• Collocated temperature sensor or psychrometer test
Met One Model 083-1-34	Relative Humidity, 0-100%	• Collocated psychrometer test
Li-Cor Model LI-200	Solar Radiation, 0-1400 watts per square meter	• Collocated test with certified pyranometer
Met One Model 375	Precipitation, inches (resolution 0.01 inches)	• Buret with known volume of water

[1]Instantatneous readings for each parameter are transmitted to the base station once per minute, which in turn calculates both 5-minute and 60 minute averages. The meteorological data and TSP data are compiled into a single data file.

B.9.1 Calibration Procedures

Figure B.9-1 shows a meteorological calibration reporting form for an identical meteorological system at another site. That same approach and format will be used at the Midnite Mine. The meteorological calibration procedures are briefly discussed below:

Wind Direction

First, the orientation of the wind direction sensor with respect to true north will be established using a solar sighting, or by calculation using two GPS location readings with a resolution of 0.001 minutes of latitude and longitude. Next, the sensor will be checked with a linearity fixture at 30-degree intervals to verify that its responses are consistent throughout its operating range of zero to 360 degrees. (Maximum allowable error is +/- 4 degrees.)

Wind Speed

Synchronous motors will be used to check the wind speed sensor's responses to known rotation rates of 0, 300 and 600 rpms. Additionally, the sensor's bearings will be checked for any signs of resistance or grittiness. (Maximum allowable error is +/- 0.5 mph.)

Temperature

The temperature sensor will be checked by taking collocated readings with a NIST-traceable collocated temperature sensor or psychrometer. (Maximum allowable error is +/- 1.8°F.)

Relative Humidity

The relative humidity sensor will be checked by taking collocated dry-bulb and wet-bulb temperature readings using a NIST-traceable psychrometer. A saturation vapor pressure table then will be used to calculate a known relative humidity from those readings. (Maximum allowable error is +/- 7% relative humidity.)

Solar Radiation

The solar radiation sensor will be checked by taking collocated readings with a certified NIST-traceable solar radiation sensor or pyranometer. (Maximum allowable error is +/- 5% of full scale.)

Precipitation

The tipping-bucket rain gauge will be checked by slowly introducing a known volume of water from a buret or graduated cylinder, and comparing the number of bucket tips against the expected value. (Maximum allowable error is +/- 10%.)

B.9.2 Maintenance

The meteorological sensors are designed for trouble-free operation in harsh weather conditions. Maintenance requirements are briefly discussed below:

Wind Direction / Wind Speed

The wind direction and wind speed sensor bearings should be replaced once per year. The wind direction sensor's potentiometer should be replaced every two years.

Temperature / Relative Humidity

Both sensors will be inspected during each calibration. Neither requires maintenance unless there is obvious physical damage, or calibration check results become unsatisfactory.

Solar Radiation

The solar radiation sensor should be re-certified or replaced in the event that its calibration results are unsatisfactory. This sensor will normally operate for several years with no maintenance other than occasional cleaning.

Precipitation

The gauge's collection funnel and buckets should be wiped out during each calibration check. The buckets' adjusting screws can be re-set if the calibration begins to drift.

Figure B.9-1: Example of Meteorological Calibration Results

BISON ENGINEERING, INC.

Bison Engineering

Meteorological Parameters Calibration Form

Date:	09/17/2015	Tower Lowered :	1551 MST on 9/17
Client:	***Example***	Tower Back Up :	1630 MST on 9/17
Site:	***Example***		
Performed By:	Steve Heck		

Temperature

Site Sensor: Met One 083-1-35, Serial No. R17163
Sensor Height: 2.5 meters
Reference Std.: Fan-Aspirated Psychrometer

Reference Value ^{o}F	Site Value ^{o}F	Diff. ^{o}F
59.1	60.1	1.0

Wind Direction

Site Sensor: Met One 034B, Serial No. R18846
Sensor Height: 3 meters
Design Locked Orientation: 180 deg. true north

Orientation (GPS sighting): 181.2 deg. true north
GPS coordinates of wind vane:
Lat 42 deg 54.465 min N, Long 112 deg 32.5555 min W
GPS coordinates of sighting point:
Lat 42 deg 54.447 min N, Long 112 deg 32.5555 min W
Sensor reading in locked position: 178.6

Linearity Fixture: Met One degree wheel

Wind Direction Linearity Checks

Setpoint	Rdg.	Diff
0	0.6	0.6
30	29.3	-0.7
60	60.7	0.7
90	89.3	-0.7
120	120.1	0.1
150	148.9	-1.1
180	178.6	-1.4
210	208.2	-1.8
240	238.2	-1.8
270	268.0	-2.0
300	297.7	-2.3
330	329.1	-0.9
	Max Diff	**-2.3**

Wind Speed

Site Sensor: Met One 034B, Serial No. R18846
Sensor Height: 3 meters
Reference Std: Met One 300 rpm & 600 rpm synchronous motors

Synchronous motor checks

Known Value RPM	Known Value mph	DAS Value mph	DAS Diff. mph
0	0.00	0.00	0.00
300	18.49	18.50	0.01
600	36.38	36.37	-0.01

Relative Humidity

Site Sensor:	Met One 083-1-35, Serial No. R17163
Sensor Height:	2.5 meters
Reference Std.:	Assmann Psychrometer

BP = 25.63 in. Hg

Ref Dry-Bulb:	15.6	deg C
Ref Wet-Bulb	9.3	deg C
Ref RH:	46.7	%RH
Station RH:	52.0	%RH
Diff:	5.3	%RH

Precipitation

Site Sensor:	Met One Model 375, S/N R17058
Sensor Height:	~0.5 meters

559 ml water added to 8-inch opening, 0.01 inches of precipitation per tip
Calibration is 8.24 ml per tip
Known value is 559 / 8.24 = 67.8 tips (so 67 full tips expected)

Unit registered 64 tips
% difference from expected = -4.5%   Repaired / adjusted so buckets would tip correctly

Solar Radiation

Time (MST)	Audit SR W/m2	Site SR W/m2	Diff. %
1630	408	424	3.8
1637	394	409	3.7
1641	355	367	3.3

B.10 REFERENCES

1. *Laboratory Evaluation of Real-Time Smoke Particulate Monitors.* USDA Forest Service Technology and Development Program. December 2003.

2. *E-Sampler Operation Manual (E-SAMPLER-9800-Rev K)*. Met One Instruments, Inc.

3. *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume I - A Field Guide to Environmental Quality Assurance*. United States Environmental Protection Agency. EPA/600/R-94/038a. April 1994.

4. *EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5.* United States Environmental Protection Agency, Office of Environmental Information. EPA/240/B-01/003. March 2001.

5. *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Part 1, Ambient Air Quality Monitoring Program Quality System Development.* United States Environmental Protection Agency OAQPS. EPA-454/R-98-004. August 1998.

BLANK FORMS

MET ONE E-SAMPLER CALIBRATION CHECKS

LOCATION: ______________________________

DATE/TIME: ______________________________ PST

SAMPLER S/N: ______________________________

RADIO NO.: ______________________________

TSP CAL FACTOR: ______________________________

SELF-TEST FREQ: ______________________________

PERFORMED BY: ______________________________

TETRA CAL S/N: ______________

TIME CHECK (MST)

SAMPLER T ERROR ______________ CORRECTED? ______________

FLOW RATE (LPM) (Allowable error = ≤ +/- 4.0%)

SAMPLER IND. ______________ TETRA CAL ______________

% Difference = 100 x (Sampler Ind.- Tetra Cal)/Tetra Cal) ______________ %

Pass ______________ Fail__________

AMBIENT TEMP (°C) (Allowable error = ≤ +/- 2.0 °C)

SAMPLER IND. ______________ TETRA CAL (Tf) ______________

Difference = (Sampler Ind. - Tf) ______0______ °C

Pass ______________ Fail__________

BAROMETRIC PRESSURE (mmHg) (Allowable error = ≤ +/- 1000 Pa)

SAMPLER ______________ Pa

TETRA CAL ______________ mmHg

TETRA CAL x 133.3= ______________ Pa

Difference = (Sampler - Tetra Cal) = ______________ Pa

Pass ______________ Fail__________

LEAK CHECK (LPM) (Allowable = ≤ 0.2 LPM)

SAMPLER ______________ LPM

Pass ______________ Fail__________

COMMENTS:

FILTERS?

E-SAMPLER FILTER TEST

A. FILTER INFORMATION

Filter Type___________________________

Filter Number_________________________

Cassette Number_______________________

B. FILTER INSTALLATION INFORMATION

E-Sampler Number___________________________________

Radio Number______________________________________

Location at Time of Filter Installation____________________

Installed By____

Date____

Time____

Leak Check Result after Filter Installation__________ LPM

(*must be ≤ 0.2 LPM)*

C. FILTER REMOVAL INFORMATION

E-Sampler Number___________________________________

Radio Number_______________________________________

Location at Time of Filter Removal______________________

Removed By____

Date____

Time____

Confirm Blank Filter Holder is Reinstalled_________________

Leak Check Result after Filter Holder Re-installed _________LPM

(must be ≤ 0.2 LPM)

D.COMMENTS

Date:_______________ Alarm Start Time:____________

Prepared By:___________________ Organization:_______________________

A. TSP Readings for Alarming E-Samplers, ppb (enter N/A if sampler not alarming)

ES-1	ES-2	ES-3	ES-4	ES-5	ES-6	ES-7	ES-8

B. Meteorological Conditions at Time of Alarm

Wind Speed (mph)	Wind Dir. (degrees)	Temperature (°F)	Relative Humidity (%)	Solar Radiation (W/m^2)	Daily Precipitation (inches)

Was fog present?_______________ Was precipitation occurring?________________

C. Describe Activity in Vicinity of Alarming Sampler(s) and Identify Remediation Area. Note Whether Site was Visited, and if Photos and/or Video Clips were Taken.

____

____

____

____

D. Indicate Alarm Causes Below as Appropriate (Check Box)

On-Site Activities	Weather Conditions	Off-Site Activity	Regional Source

E. Describe Actions Requested of Construction Contractor, and Time Completed.

____

____

____

____

MDINITE MINE TSP ALARM RECORD (Page 2 of 2)

F. Record of Alarm Notifications (Should be Made in Order Shown)

Name	Organization / Title	Telephone Number	Time Notified
	Construction QA Officer		
	Construction Contractor		
	DMA / Newmont Site Manager		
	WME Supervising Contractor		
	EPA Project Manager		

G. TSP Readings Following Actions, ppb (enter N/A if sampler was not alarming)

ES-1	ES-2	ES-3	ES-4	ES-5	ES-6	ES-7	ES-8

H. Evaluate Effectiveness of Response Actions (if not effective, state why)

____

____

____

I. Other Comments / Observations

____

____

____

____

____

____

____

Appendix C:

Visible Emissions Field Manual, EPA Methods 9 and 22

EPA 340/1-92-004
December 1993

Visible Emissions Field Manual
EPA Methods 9 and 22

Prepared by:

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US. ENVIRONMENTAL PROTECTION AGENCY
Stationary Source Compliance Division
Office of Air Quality Planning and Standards
Washington, DC 20460

December 1993

Contents

Introduction

The Federal opacity standards for various industries are found in 40CFR Part 60 (Standards of Performance for New and Modified Stationary Sources) and 40 CFR Part 61 and 62 (Emission Standards for Hazardous Air Pollutants). These standards require the use of Reference Method 9 or Reference Method 22, contained in Appendix A of Part 60, for the determination of the level or frequency of visible emissions by trained observers.

In addition to the plume observation procedures, Method 9 also contains data reduction and reporting procedures as well as procedures and specifications for training and certifying qualified visible emission (VE) observers.

State Implementation Plans (SIPs) also typically include several types of opacity regulations, which in some cases may differ from the federal opacity standards in terms of the opacity limits, the measurement method or test procedure, or the data evaluation technique. For example, some SIP opacity rules limit visible emissions to a specified number of minutes per hour or other time period (time exemption); some limit opacity to a certain level averaged over a specified number of minutes (time averaged); some set opacity limits where no single reading can exceed the standard (instantanous or "cap"). Regardless of the exact format of the SIP opacity regulations, nearly all use the procedures in Method 9 for conducting VE field observations and for training and certifying VE observers. The observation procedures contain instructions on how to read the plume and record the values, including where to stand to observe the plume and what information must be gathered to support the visible emission determinations. The validity of the VE determinations used for compliance or noncompliance demonstration purposes depends to a great extent on how well the field observations are documented on the VE Observation Form. This field manual will stress the type and extent of documentation needed to satisfy Method 9 requirements.

FEDERAL AND STATE OPACITY STANDARDS ARE INDEPENDENTLY ENFORCEABLE AND SERVE AS A PRIMARY COMPLIANCE SURVEILLANCE TOOL

Federal opacity standards and most SIP opacity regulations are independently enforceable, i.e., a source may be cited for an opacity violation even when it is in compliance with the particulate mass standard. Thus, visible emission observations by qualified agency observers serve as a primary compliance surveillance tool for enforcement of emission control standards. In addition, many federal and SIP regulations and construction and operating permits also require owners/operators of affected facilities to assess and report opacity data during the initial compliance tests and at specified intervals over the long term.

A NSPS OR SIP OPACITY VIOLATION CAN RESULT IN A FINE OF $10,000 TO $25,000

Regulated sources may be subject to stiff penalties for failure to comply with federal and state emission standards, including opacity standards. Civil and administrative penalties of up to $25,000 per day per violation can be assessed under the Clean Air Act (CAA). States and local agencies are encouraged under Title V of the CAA to have program authority to levy fines up to $10,000 per day per violation. Therefore, visible emission determinations for compliance demonstration or enforcement purposes must be made accurately and must be sufficiently well documented to withstand rigorous examination in potential enforcement proceedings, administrative or legal hearings, or eventual court litigation.

Procedural errors or omissions on the visible emission evaluation forms or data sheets can invalidate the data or otherwise provide a basis for questioning the evaluation. Only by carefully following the procedures set forth in Method 9 (or any other reference method) and by paying close attention to proper completion of the VE Observation Form can you be assured of acceptance of the evaluation data.

The purpose of this simplified manual is to present a step-by-step field guide for inexperienced VE observers who have recently completed the VE training and certification tests on how to conduct VE observations in accordance with the published opacity methods. The basic steps of a well-planned and properly performed VE inspection are illustrated in the inspection flow chart (see Figure 1). This manual is organized to follow the inspection flow chart. Sections of the reference methods that must be carefully observed or followed during the inspection are highlighted. Method 9 and Method 22 are reprinted in full in Appendix B and Appendix C respectively. A recommended field VE Observation Form, included in Appendix A, may be copied or modified for field use.

It should be noted that much of the information presented in this simplified field manual has been derived from a number of previously published technical guides, manuals, and reports on Method 9 and related opacity

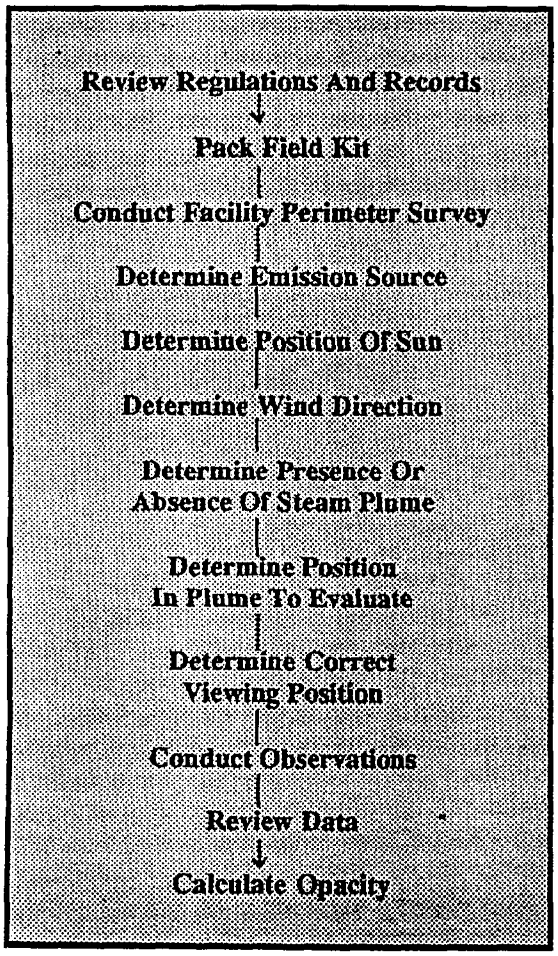


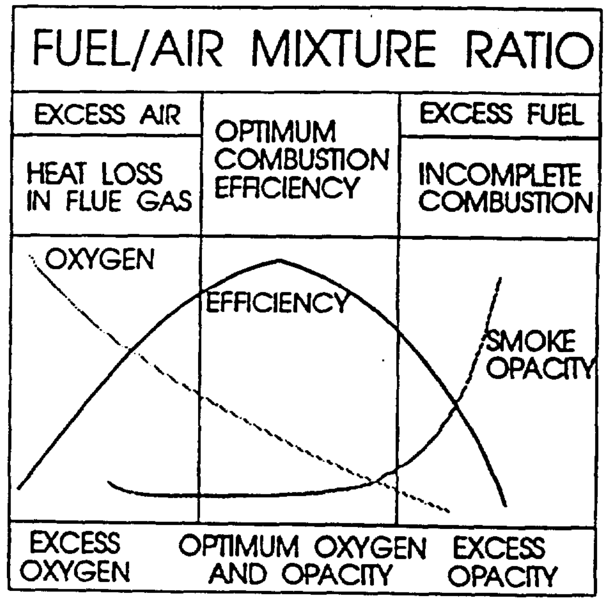
Figure 1. VE Inspection Flow Chart

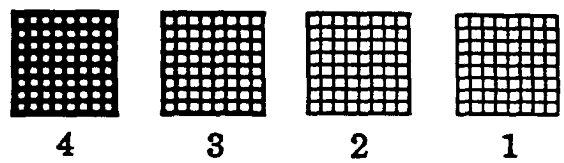
methods. For more detailed information on Method 9 and the application of Method 9, please consult the list of publications at the end of this manual.

A Brief History Of Opacity

Early History

The first smoke evaluation system evolved from a concept developed by Maximillian Ringelmann in the late 1800s. Ringelmann realized that black smoke from coal-fired boilers was the result of poor combustion efficiency. Darker smoke meant poorer efficiency, and to measure the darkness of the smoke, Ringelmann devised a chart with four different black grids on a white background. At a distance of at least 50 feet, the grids on the chart appear as shades of gray. By matching the shade of a smoke plume with the apparent shade of a grid on the chart, Ringelmann was able to classify emissions. With this information, he could adjust the fuel-to-air ratio of a furnace to increase efficiency and decrease the smoke. The Ringelmann Chart was adopted and promoted by the U.S. Bureau of Mines in the early 1900s in their efforts to improve coal combustion practices. It has been used extensively ever since by industry and control agencies to assess and control emissions.





Ringelmann Chart

Ringelmann Period

By 1910, many larger municipalities had adopted the Ringelmann Chart into their health and safety regulations in an attempt to control smoke as a nuisance. To prove a violation of a nuisance code, it was necessary to prove that:

- The smoke was dense
- The smoke was a nuisance

Between 1914 and the 1940s, the courts recognized that smoke could be regulated under the police power of the state, and a regulatory agency no longer had to prove that the smoke was a nuisance. The U.S. Surgeon General declared that smoke and other air pollutants were not only a nuisance but a health hazard in 1948 after a series of air-pollution-related deaths in Donora, Pennsylvania. This set the stage for federal regulations and the control of air pollution to protect the public health.

Equivalent Opacity

In the 1950s and 1960s Los Angeles added two major refinements to the use of visible emissions as a tool for controlling particulate emissions. The Ringelmann method was expanded to white and other colors of smoke by the introduction of "equivalent opacity." Equivalent opacity meant that the white smoke was equivalent to a Ringelmann number in its ability to obscure the view of a background. In some states, equivalent opacity is still measured in Ringelmann numbers, whereas in others the 0-to 100-percent scale is used. Also, by training and certifying inspectors using a smoke generator equipped with an opacity meter, regulatory agencies ensured that certified inspectors did not have to carry and use Ringelmann cards.

In 1968, the Federal Air Pollution Control Office published AP-30, Optical Properties and Visual Effects of Smoke-Stack Plumes, describing the accuracy of a smoke reader's observations compared to a transmissometer. AP-30 also discussed the effect on opacity observations when a plume is viewed with the sun in the wrong place relative to the source.

Method 9

The Environmental Protection Agency (EPA) stopped using Ringelmann numbers in the New Source Performance Standards when the revised EPA Method 9 was promulgated in 1974. All NSPS visible emission limits are stated in percent opacity units. Although some state regulations (notably California's) still specify the use of the Ringelmann system for black and gray plumes, the national trend is to read all emissions in percent opacity.

EPA conducted extensive field studies on the accuracy and reliability of the Method 9 opacity evaluation technique when the method was revised and repromulgated in response to industry challenges concerning certain NSPS opacity standards and methods. The studies showed that visible emissions can be assessed accurately by properly trained and certified observers. Two central features of Method 9 involve taking opacity readings of plumes at 15-second intervals and averaging 24 consecutive readings (6 minutes) unless some other time period is specified in the emission standard (some NSPS specify a 3-minute averaging period).

Plume opacity emission standards and requirements remain the mainstay of federal, state, and local enforcement efforts. Today, more visible emission observers are certified annually than at any time in the past. This certification rate will continue to increase with the increase of federal and state regulations on industrial processes and combustion sources such as municipal, medical, and hazardous waste incinerators. Visible emissions standards are also applied extensively in controlling fugitive emissions from both industrial processes and non-process dust sources such as roads and bulk materials storage and handling areas. Often there are no convenient accurate stack testing methods for measurement of emissions from unconfined sources other than opacity methods.

METHOD 22 IS A QUALITATIVE TECHNIQUE CONCERNED ONLY WITH THE PRESENCE OR ABSENCE OF AN EMISSION

Method 22

Since EPA promulgated Method 22 in 1982, it has become an important tool in the control of visible emissions. Method 22 is a qualitative technique that checks only the presence or absence of visible emissions. Method 22 or a similar method is often used in the regulation of fugitive emissions of toxic materials. Unlike with Method 9, Method 22 users don't have to be certified. However, a knowledge of observation techniques is essential for correct use of the method. Therefore, Method 22 requires the observer to be trained by attending the lecture and field practice session of the Method 9 smoke school.

Opacity Measurement Principles

The relationships between light transmittance, plume opacity, and Ringelmann numbers are presented in Table 1.

Ringelmann	Opacity	Transmittance
1	20	80
2	40	60
3	60	40
4	80	20
5	100	0

Table 1. Comparison of Ringelmann Number, Plume Opacity, and Light Transmittance

A literal definition of plume opacity is the degree to which the transmission of light is reduced or the degree to which the visibility of a background as viewed through the diameter of a plume is reduced. In simpler terms, opacity is the obscuring power of the plume, expressed in percent. In physical terms, opacity is dependent upon transmittance (I/I_o) through the plume, where I_o is the incident light flux and I is the light flux leaving the plume along the same light path. Percent opacity can be calculated using the following equation:

Percent opacity = $(1-I/(I_o) \times 100$.

Variables Influencing Opacity Observations

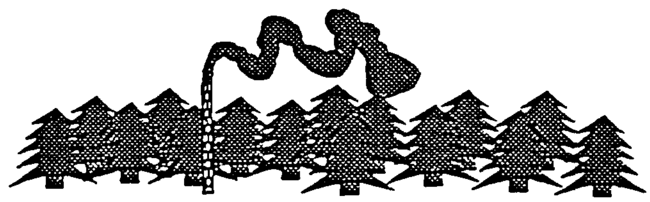
Method 9 advises:

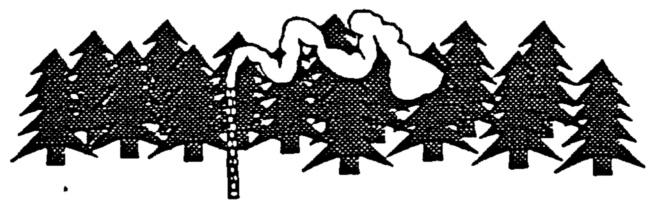
> The appearance of a plume as viewed by an observer depends upon a number of variables, some of which might be controllable and some of which might not be controllable in the field.
>
> The factors that influence plume opacity readings include particle density, particle refractive index, particle size distribution, particle color, plume background, pathlength, distance and relative elevation to stack exit, sun angle, and lighting conditions.

Particle size is particularly significant; particles decrease light transmission by both scattering and direct absorption. Particles with diameters approximately equal to the wavelength of visible light (0.4 to 0.7 μm) have the greatest scattering effect and cause the highest opacity. For a given mass emission rate, smaller particles will cause a higher opacity effect than larger particles. You should note that particles in the size range of 0.5 μm to 8 μm which typically cause most of the plume opacity, are also in the respirable range and are designated as PM_{10} particles.

Variables that might be controllable in the field are luminous contrast and color contrast between the plume and the background against which the plume is viewed. These variables exert an influence on the appearance of a plume and can affect an observer's ability to assign opacity values accurately. For example, when either contrast is high, the effect of the plume on the background is more evident and opacity values can be assigned with greater accuracy. When both contrasts are low, such as in the case of a gray plume on an overcast cloudy day, the effect is low and negative errors will occur. A negative error is when the observer under-estimates the true opacity of the plume.

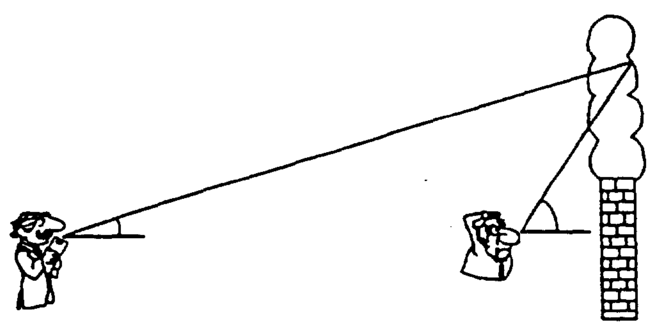
An example of high luminous contrast is a black plume against a light sky. Two objects of the same color could show up against each other because of differences in lighting levels or light direction. This effect is particularly important when the sun is behind a plume, thereby making the plume more luminous than the background and creating a high bias (positive error) in opacity readings. On the other hand, when the sun is properly oriented in relation to the plume and the plume color is identical with the background color, observers will generally have difficulty distinguishing between the plume and the background.



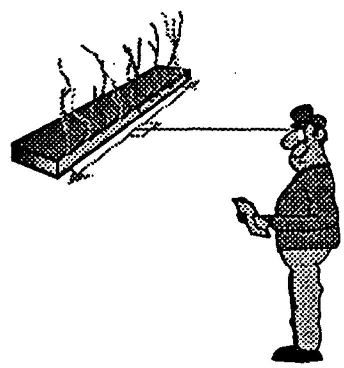


The line-of-sight pathlength through the plume is of particular concern. Method 9 states:

...the observer shall, as much as possible, make his observations from a position such that his line of vision is approximately perpendicular to the plume direction, and when observing opacity of emissions from rectangular outlets (e.g., roof monitors, open baghouses, noncircular stacks), approximately perpendicular to the longer axis of the outlet.



If the line of sight varies more than 18° from the perpendicular, a positive error greater than 1 percent occurs. As the angle increases, the error increases. When observing plumes from conventional sources, observers should stand at least three stack distances away from a vertically rising plume to meet this requirement. When observing plumes from fugitive sources, which are rarely perfectly round and are strongly affected by the wind, observers must take care to meet this requirement.



Measurement Error

All measurement systems have an associated error, and Method 9 is no exception. As a result of field trials conducted at the time Method 9 was promulgated, the error levels at two confidence intervals for white and black smoke using Method 9 were determined. The method states:

> For black plumes (133 sets at a smoke generator) 100 percent of the sets [average of 25 readings] were read with a positive error of less than 7.5 percent opacity; 99 percent were read with a positive error of less than 5 percent opacity.
>
> For white plumes (170 sets at a smoke generator, 168 sets at a coal-fired power plant, 298 sets at a sulfuric acid plant), 99 percent of the sets were read with a positive error of less than 7.5 percent opacity; 95 percent were read with a positive error of less than 5 percent opacity.

This means that during these field trials 100 percent of the black plumes and 99 percent of the white plumes were not overread by more than 7.5-percent opacity. In other words, there is only a 1-percent chance that an observer will exceed the error on a white plume and no chance that an observer will exceed the error on a black plume. Negative biases due to low-contrast observation conditions will often further offset the observational error.

Ninety-nine percent of the black plumes and 95 percent of the white plumes were read within 5 percent opacity. This means that an overreading occurs only about once in 20 readings. Again, negative biases that result from poor observation conditions (low plume-to-background contrast) reduce the positive observational error.

Later field studies have shown slightly higher observation errors, but they are still within the 7.5-percent opacity measurement error at two confidence intervals. These studies also showed that positive error is reduced by increasing the number of observations in either averaging time or in number of averages. Both techniques improve the accuracy of the method.

Method 22

Method 22 is used in conjunction with emission standands or work practices in which no visible emissions is the stated goal. This is frequently the case with fugitive emission sources or sources with toxic emissions. Method 22 differs from Method 9 in that it is qualitative rather than quantitative. Method 22 indicates only the presence or absence of an emission rather than the opacity value. Thus, many of the provisions of Method 9 that enhance the accuracy of the opacity measurement are not necessary in Method 22 determinations. Method 22 does not require that the sun be the light source or that you stand with the sun at your back. In fact, for reading asbestos emissions regulated under NESHAP Subpart *M*, you are directed to look toward the light source to improve your ability to see the emission. Under Method 22, the duration of the emission is accurately measured using a stopwatch. Table 2 on the following page compares major features of Method 9 and Method 22.

Table 2. Comparison Of Methods 9 & 22

	Method 9	Method 22
Applicability	Any NSPS and SIP sources with an opacity standard, such as 20 percent.	NSPS and SIP fugitive and specified flare sources with a "no visible emission" standard. No opacity level can be specified.
Measurement	The method determines the value of the opacity measured.	The method determines the existence of a plume but not the opacity.
Certification	Observer must demonstrate the ability to measure plumes in the field every six months.	Observer is not required to participate in field certification.
Lecture	Observer is not required to attend a lecture program.	Observer must be able to demonstrate knowledge. A lecture is advised, but reading material is acceptable.
Distance From Source	No distance is specified, but the observer must have a clear view of the emissions.	From 15 feet to 0.25 mile.
Viewing Angle	Observer views the plume from a position that minimizes the line of sight through the plume to minimize positive bias.	Observer simply observes the plume.
Light Source	The sun is implied as the light source and it is required to be at the observer's back.	Light sources other than the sun are acceptable but must be documented. The light must be at least 100 lux, but, it is not required to be at the observer's back.
Viewing Times	Momentary observation every 15 seconds for a period determined by the standard. Each observation is recorded.	Continuous viewing with observer rest breaks every 15 to 20 minutes. The observer times the emissions with a stopwatch and records the duration of emissions.

Records Review

Standard Visible Emission Inspection

The standard VE observation starts with a review of the source records on the emission point of interest. This initial review of the records can prevent considerable confusion and lost time in the field. You might not have the opportunity to make the review before the inspection, in which case the documentation should be completed after the review. The following paragraphs describe the items that should be checked.

The regulatory requirements and compliance status of the emission point are critical. To use the correct measurement method and the correct data-reduction technique, you must know which regulations apply.

SOURCES ARE REGULATED UNDER:

NSPS
SIPs
Compliance agreements
Permit conditions
Enforcement decrees

You must determine whether the emission point is regulated under federal New Source Performance Standards (NSPS), the State Implementation Plan (SIP), special permit conditions, or compliance order/agreement conditions. You must check each potentially applicable regulation; if you do not, you might use the wrong test method or data-reduction method. You cannot rely entirely on the Method 9 procedure in Appendix A of 40CFR Part 60. If the source is NSPS- regulated, special procedures or other modifications could be included in the emission standard for a specific source category.

SIP regulations often stipulate procedures that vary from Method 9, even though Method 9 or a similiar method is referenced in the SIP regulation. These variances could be in the observation procedures, in certification requirements, or in the data-reduction technique. The 15-second opacity values could be reported as time duration (time aggregation), or as shorter or longer averages than 6 minutes, or as the number of individual values above a "cap" (not to exceed rules). You should check the applicability of the standard to the specific process unit, and you should also check for exempt operating conditions, such as start-up, malfunction, and shut-down.

Another source of information regarding the applicable standards as well as observation and data reduction procedures for a source is the operating permit. Special conditions are often placed in the permit. Also, any negotiated compliance orders or agreements pertaining to the source may contain references to opacity standards and compliance methods or other written procedures.

Previous observations that have been made by the source, your agency, or another agency should be reviewed. Check for photographs of the source, and make copies to take on the evaluation to help in identifying emission points, performing observations in a consistent manner, and documenting changes in plant equipment.

EACH SOURCE AT A FACILITY CAN HAVE A DIFFERENT COMPLIANCE STATUS, A DIFFERENT RULE, A DIFFERENT OBSERVATION METHODOLOGY, AND A DIFFERENT DATA REDUCTION METHOD. ALSO, THE STATUS OF A SOURCE CAN CHANGE OVER TIME.

Review any available videotape to get a feel for the site and the emissions. VE Observation Forms from previous inspections should be evaluated to determine whether steam plumes or other unusual conditions exist. Check inspection reports for viewing conditions or locations.

Maps and plot plans are often found in the agency source file, which will help you in determining good observation positions and their access. Time can be saved by using the maps and plot plans and calculating the sun's position at different times of the day.

Emission test reports are a good source of data on the stack height, source type, and compliance status with other regulations such as mass emissions regulations. Stack temperature and moisture content can be used to determine whether a steam plume could potentially be present on the day of your observation using the technique described in the EPA Quality Assurance Handbook, Volume III, Section 3.12.

Some emission reports have data on particle size distribution. This information is useful when observing a plume. Small particles impart a bluish haze to a plume, because the particles scatter blue light preferentially. The test data might reveal whether there are condensable emissions in the gas stream. This information is helpful in determining whether any residual plume is due to water or to a complex plume reaction.

Stack test reports usually contain descriptions of control equipment and their operating conditions. This information is useful in determining whether there is potential for a water condensation plume to form

CARRY THE FILLED-IN FORM WITH YOU IN THE FIELD

Lastly, fill in a sample VE Observation Form with the data that you have collected so that you have a ready reference when you go into the field. It is also useful to copy a map onto the back of the field forms you plan to use to help locate or verify the exact observation point.

Reverse Observations

Sometimes, you must make VE observations before a formal record review. Impromptu observations are often necessary when an opacity event is discovered. In this case, you will not have time for an extensive pre-inspection data review. Document what you can determine accurately in the field and complete the documentation as soon as possible after the observation. Visible emissions records used in court are treated as evidence under the principle of past recollection recorded. This means that you wrote it down while it was still fresh in your mind. If you must change an entry due to new knowledge obtained in the file review:

1. Draw a thin line through the error WITHOUT OBLITERATING IT.
2. Write the correction above it in ink.
3. Initial and date the change.

Equipment

Method 9 does not contain any special requirements or specifications for equipment or supplies; however, certain equipment is necessary to conduct a valid observation that will withstand the rigors of litigation. Other equipment, though optional, can make the collection of high-quality data easier. This section gives specifications, criteria, or design features for the recommended basic VE equipment.

Clipboard And Accessories

You should have a clipboard, several black ballpoint pens (medium point), several large rubber bands, and a sufficient number of VE Observation Forms to document any expected and unexpected observations. Use black ballpoint pens so that completed forms can be copied and still remain legible over several reproduction generations. Rubber bands hold the data form flat on the clipboard under windy conditions and hold other papers and blank forms on the back of the clipboard. Use observation forms that meet EPA Method 9 requirements. Sample forms that have been extensively field tested are provided in Appendix A.

Timer

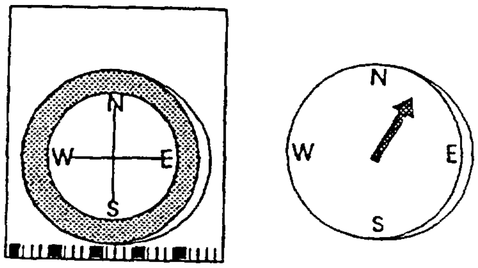
During a VE observation, it is necessary to time the 15-second intervals between opacity readings. You have a choice between using a watch or dedicated timer. The best practice is to attach two dedicated timers to your clipboard. Liquid-crystal-display timers are preferred because of their accuracy and readability. Use one timer to determine the start and stop times of the observation and the other timer to provide a continuous display of time to the nearest second. You can set most stick-on timers to run from 1 to 60 seconds repeatedly. A timer with a beeper that sounds every 15 seconds is recommended for use in some industrial locations, because you can then pay attention to your surroundings and your safety and not the timer.

CHECKLIST

- **Clipboard**
- **Ballpoint pens**
- **VE forms**
- **Rubber bands**
- **Timers (2)**
- **Compass**
- **Topographic map**
- **Rangefinder**
- **Clinometer**
- **Sling psychrometer**
  - **Water**
- **Binoculars**
- **Camera**
  - **Film**
  - **Tripod**
  - **Telephoto lens**
  - **Macro lens**
- **Video camera**
  - **Tape**
  - **Batteries**
  - **Tripod**

Compass

A compass is needed to determine the direction of the emission point from the spot where you stand to observe the plume and to determine the wind direction at the source. Select a compass that you can read to the nearest 2°. The compass should be jewel-mounted and liquid-filled to dampen the needle's swing. Map-reading compasses are excellent for this purpose. Because you must take the magnetic declination for your area into account when you take the reading, you should consider investing in a compass that allows presetting the declination.



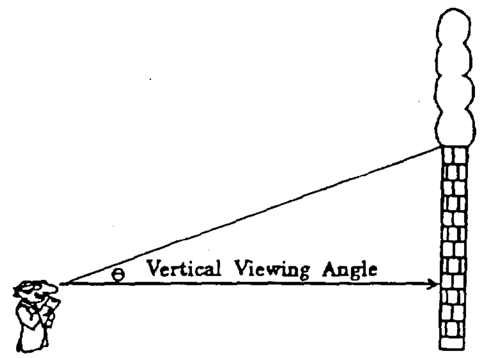
Topographic Maps

United States Geological Survey (USGS) 7.5-minute topological maps are a practical necessity for serious opacity work. From these maps you can determine your exact location, true north, distances, access roads, latitude, longitude, magnetic declination, relative ground height, and background features. You also can use these maps to calibrate rangefinders. If you are planning an inspection, photocopy the section of the map that shows the facility on the back of your observation form. Laminate the full-sized map for field use and to allow for temporary marking with dry erasable pens.

Rangefinder

If you do not have a topographic map of the area, you will need a rangefinder. Even with a map, a rangefinder is useful in field work. The two types in general use are the split-image and the stadiometric rangefinders. The split-image type uses the technique of superimposing one image over another to determine the distance. The most useful models for most opacity work have a maximum range of about 1,000 yards. To use the stadiometric rangefinder, you must know the height or width of an object at the same distance as the object of interest. Stadiometric rangefinders are lighter and more compact than split-image rangefinders. Split-image rangefinders, although inherently more accurate, are more likely to become uncalibrated if bumped during transport. The accuracy of either type of rangefinder should be checked on receipt and periodically thereafter with targets at known distances of approximately 100 meters and 1,000 meters. Any rangefinder must be accurate to within 10 percent of the measurement distance.

Clinometer

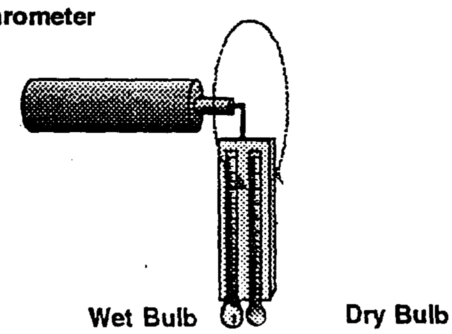


You will need a clinometric device for determining the vertical viewing angle. For visible emission observation purposes, it should be accurate within 3°. Many suitable devices are available in a wide range of prices, including Abbney levels, pendulum clinometers, and sextants. Abbney levels use a bubble in a curved tube to determine the angle with an accuracy of 1° to 2°. The pendulum clinometer is the cheapest and has an accuracy of about 2° when used properly. It consists of a protractor and a plum bob. A sextant is very accurate but more expensive, and you will need to know the position of the actual horizon.

Sling Psychrometer

If there is a potential for the formation of a condensed water droplet "steam" plume, you will need a sling psychrometer to determine the temperature and relative humidity of the atmosphere. The sling psychrometer consists of two thermometers, accurate to 0.5°C, mounted on a sturdy assembly attached to a chain or strap. One thermometer has a wettable cotton wick surrounding the bulb. Thermometer accuracy should be checked by placing the bulbs in a deionized ice water bath at 0°C. Electronic models that use newly developed solid state sensors are also available and do not have to be slung. Electronic models are simpler to use but require tedious periodic calibration using standard salt solutions.

Sling Psychrometer



Binoculars

Binoculars are helpful for identifying stacks, searching the area for emissions and interferences, and helping to characterize the behavior and composition of the plume. Binoculars are designated by two numbers, such as 7 x 35. The first number is the magnification and the second is the field of view. Select binoculars with a magnification of 8 or 10 (8 x 50 and 10 x 50 are standard designations). The binoculars should have color-corrected coated lenses and a rectilinear field of view. Check the color correction by viewing a black and white pattern, such as a Ringelmann card, at a distance greater than 50 feet. You should see only black and white: no color rings or bands should be evident. Test for rectilinear field of view by viewing a brick wall at a distance greater than 50 feet. There should be no pincushion or barrel distortion of the brick pattern. Plume observations for compliance purposes should not be made through binoculars unless you are certified with binoculars.

35 MM Camera And Accessories

Use a camera to document the presence of emissions before, during, and after the actual opacity determination and to document the presence or lack of interferences. Photographs document the specific stack that is under observation but do not document the exact opacity. Select a 35-mm camera with through-the-lens light metering, a "macro" lens or a 250 to 350-mm telephoto lens, and a 6-diopter closeup lens (for photographing the photo logbook). A photo logbook is necessary for proper documentation. An example of a photo log is provided in Appendix A of this manual. Use only fresh color negative film with an ASA of approximately 100. You can get first-generation slides or prints from negatives. The first photograph is of the log, identifying the time, date, and source. Log each photograph when you take it. The last photograph is of the completed log. Instruct the processor not to cut the film or print roll so that you can refer to the photo log at the end of the roll to identify each photograph.

CARRY EXTRA ROLLS OF FRESH FILM AND USE A PHOTO LOG

Video

Video is an excellent tool for opacity work. Because of the wider tonal range of video, it does a better job of reproducing the actual appearance of the plume than photography. In terms of resolution, video is poorer than film. The best video systems for opacity work include High 8 and Super VHS. Each gives 400 lines of resolution. Edited tapes have near broadcast quality and are excellent for research and court work. Regular VHS or regular 8 resolution is poor and duplicates are even worse. Select the highest quality videotape available for your system. Set and use the automatic date and time feature when taping, title each shot in the field, and narrate while taping. A sturdy tripod is as necessary as a good camera.

ALWAYS SHOOT EACH SCENE FOR AT LEAST 3 MINUTES TO MAKE EDITING EASIER.

Field Operations

Perimeter Survey

Before making your observations you need to determine the correct viewing position for the source being monitored, and you must also identify any potential interferences. You will need to select backgrounds, determine the wind direction, and determine the position of the sun relative to the source. You also should look for unlisted sources at this time. If you do not consider each of these items, the observation could be invalid.

Determine Sources

First, determine the sources of visible emissions at the facility and identify the specific source that you are going to observe. Record the source identification on the field data sheet. Next identify any potential interferences near the source for example, other visible emission plumes from nearby sources, fugitive dusts from work activities in the line of sight or obstructing buildings. Lastly, identify any other sources that are unlisted but visible.

Determine The Position Of The Sun

Method 9 states:
The qualified observer shall stand at a distance sufficient to provide a clear view of the emissions with the sun oriented in the 140 sector to his back.

This means that a line from the sun to the observer and a line from the observer to the observation point in the plume must form an angle of at least 110 degrees. This will place the sun in the required cone-shaped 140 degree sector. The purpose of this rule is to prevent forward scattering of light transmitted in the plume. Forward scattering enhances the plume visibility and creates a positive bias in measurement results. In fact, every viewing requirement of the method is designed to prevent positive bias.

METHOD 9 OBSERVATION RULES ARE DESIGNED TO ELIMINATE POSITIVE BIAS IN READINGS

Use a compass to determine the position of the sun in terms of true north. Remember to correct the compass for the magnetic declination at the site which might be different from that at your office location. When you position yourself initially you will position the sun in a 140 degree sector to your back when you face the source. Use the sun location line on the form for this initial check.

Now you must determine whether the vertical location of

METHOD 9 DOES NOT STATE THAT THE SUN MUST BE IN A 140° HORIZONTAL SECTOR

the sun is acceptable. This is especially true under one or more of the following conditions:

- You are observing a tall stack
- The sun is high overhead
- You are observing the plume high in the sky

In the summer the sun can be as high as or higher than 60° in the sky during the solar noon (1 p.m.) at most locations in the United States. If this is the case and the plume observation point is only 15° in the vertical, the combined vertical angle (from the observation point to the observer to the sun) will violate the vertical requirements because the total of the vertical plume angle and the vertical sun angle is at least 75° (which is less than the 110° specified minimum). Finally, the horizontal and vertical angles have a combined effect. If the sun is the sun is high overhead, or if the observation point is high, or if the observation point is high and the sun is close to the edge of the acceptable position, the final angle will probably be unacceptable.

Determine The Point In The Plume To Evaluate

Method 9 provides excellent guidance on the selection of the spot in the plume to observe. This guidance is presented in several sections and, unless the method is read in its entirety, the information can be confusing. The following extractions from Method 9 address what to consider in selecting the point in the plume for the observation.

Method 9 states:

2.3 OBSERVATIONS

Opacity observations shall be made at the point of greatest opacity in that portion of the plume where condensed water vapor is not present.

This is the first and most significant criterion. It has two elements that must be adhered to:

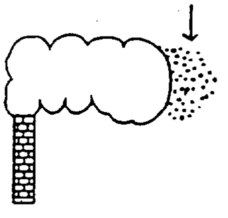
- You must read opacity at the densest portion of the plume
- There cannot be any condensed water vapor at the point of observation

If there is no condensed water droplet plume, you can read at the densest part of the plume. If there is a "steam" plume, sections 2.3.1 and 2.3.2 explain how to implement the rule.

Method 9 states:

2.3.1 ATTACHED STEAM PLUMES

When condensed water vapor is present within the plume as it emerges from the emission outlet, opacity observations shall be made beyond the point in the plume at which condensed water vapor is no longer visible. The observer shall record the approximate distance from the emission outlet to the point in the plume at which the observations are made.

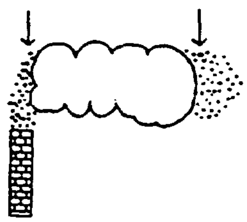


You must be sure that the condensed water aerosol has re-evaporated and is not enhancing the opacity of the particulate matter in the plume. If the relative humidity is high, water will hang on to particulate matter, and if the particulate matter is hygroscopic, the water could hang on at lower humidities. Either are unacceptable for a valid observation. You can observe the plume from the other side looking into the sun to determine where there is a real break point in the steam plume. Do not look into the sun when observing for record.

Method 9 states:

2.3.2 DETACHED STEAM PLUMES

When water vapor in the plume condenses and becomes visible at a distinct distance from the emission outlet, the opacity of emissions should be evaluated at the emission outlet prior to the condensation of water vapor and the formation of the steam plume.



(Note: The word "shall" has been changed to" should" in this subsection.)
If the steam plume is detached, you have two choices:

- Read before the steam forms
- Read after it evaporates

It is easy to choose between these options if you remember that "observations shall be made at the point of greatest opacity" is your primary rule. If the plume is denser before the steam plume forms, read there. If the plume is denser after the steam plume evaporates, read there, unless there are specific directives to the contrary.

Certain complex plumes--those with high condensable loadings or secondary reactive products--might present problems in determining where to read the plume and how to interpret the results. This is where your homework comes in. From the permits or emission test data you should have a good feel for the material being emitted. Some materials that have a strong affinity for water might retain water far longer than others. Also, if the ambient air humidity is high, there is less potential for water to evaporate from particles. In either of these cases, condensed water droplets containing particulate contaminates could mimic particulate matter. Other cases that require caution are those in which condensed hydrocarbons are the principle component of the visible plume. Some opacity regulations might not be applicable to sources with consensing hydrocarbon plumes if the intent of the emission standard was only to control primary particulate emissions detected by the emission control system. An example is the case of "blue haze" plumes from asphalt concrete batch plants, which have been determined to be exempt from the NSPS opacity requirement.

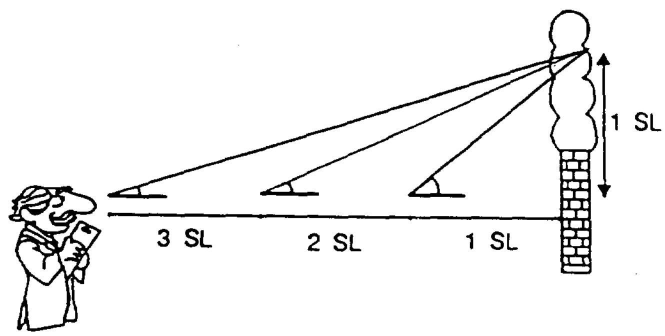
Document The Point In The Plume Where The Reading Was Taken

You must document on the data sheet the point in the plume that you selected for the opacity reading. This location should be documented in terms of distance from the stack and in relative terms to any condensed water or steam break. You can be sure that you will be challenged later on this issue if there is reason to suspect that the plume has a high moisture content or condensable emissions.

Check For Direction Of Plume Travel

Method 9 states:

[The VE observer should]...make his observations from a position such that his line of vision is approximately perpendicular to the plume direction.



If you are observing the plume, you should be at least three effective stack heights away from the plume. (The effective stack height is the vertical distance between the point where your horizontal line of sight intersects the stack and the point in the plume where the observation is to be made.) The intent is to keep within 18° of the perpendicular to the plume. If the plume is horizontal, make sure that your line of vision is approximately perpendicular to the plume at the point of observation. Again, the line of sight should be within 18° of a perpendicular to the plume line of travel. The reason for standing approximately perpendicular to the plume when making the VE determination is to use the shortest pathlength through the plume, which will result in the most conservative estimate of plume opacity.

Adjust Your Field Location If Necessary

After picking the point in the plume to observe, you must recheck that you are in the correct position relative to the sun and that point. If you are not, move. Recheck each of the same factors at the new field position and move again if necessary. Do not start observations until all the factors conform to the regulations. It might be necessary to come back at a different time of day to get all the observation conditions acceptable.

METHOD 9 IS A METHOD OF OPPORTUNITY. THE VE INSPECTION MIGHT HAVE TO BE DELAYED TO A DIFFERENT TIME OF DAY IF VIEWING LOCATION OR CONDITIONS ARE UNACCEPTABLE

Performing The Observations

Compared to the preliminary activities, observing the plume is easy. You will be filling out the upper left section of the form first. Fill in the observation date in the appropriate space on the form. Fill in the start time when you make the first observation. Use the 24-hour clock to avoid confusion with a.m. and p.m. and indicate the time zone. For example, 10:30 a.m. Eastern Daylight Time should be recorded as 1030 EDT; 2:30 p.m. Eastern Daylight Time should be recorded as 1430 EDT.

Method 9 states:

The observer shall not look continuously at the plume, but instead shall observe the plume momentarily at 15-second intervals.

Watch your timer and look up at the plume only momentarily at the 0-, 15-, 30-, and 45-second intervals. It takes only a few seconds to record your observation on the form. Record your observations in 5-percent opacity intervals unless the permit or regulation specifies otherwise. Continue until you have made the required number of observations. Method 9 usually requires at least 24 observations for a complete data set. Good measurement practice is to take more than the bare minimum required, and it might be necessary to take more than one data set to defend the observations against litigation in some courts.

IF CONDITIONS CHANGE DURING THE OBSERVATION, DOCUMENT ALL CHANGES IN THE COMMENT SECTION

There is a comment section for each minute of observation. Use these comment sections to document events that affect the validity of the observation, such as interferences or reasons for missing readings. Document changes in your position or plume color.
When you conclude your observation session, record the stop time in the appropriate section. Fill in the section on observer and affiliation. Sign and date the form. Enter the requested information concerning your last certification. A completed VE Observation Form is found on the next page.

Calculations

Method 9 Data Reduction

Method 9 states:

Opacity shall be determined as an average of 24 consecutive observations...

Divide the observations recorded on the record sheet into sets of 24 consecutive observations. A set is composed of any 24 consecutive observations. Sets need not be consecutive in time and in no case shall two sets overlap.

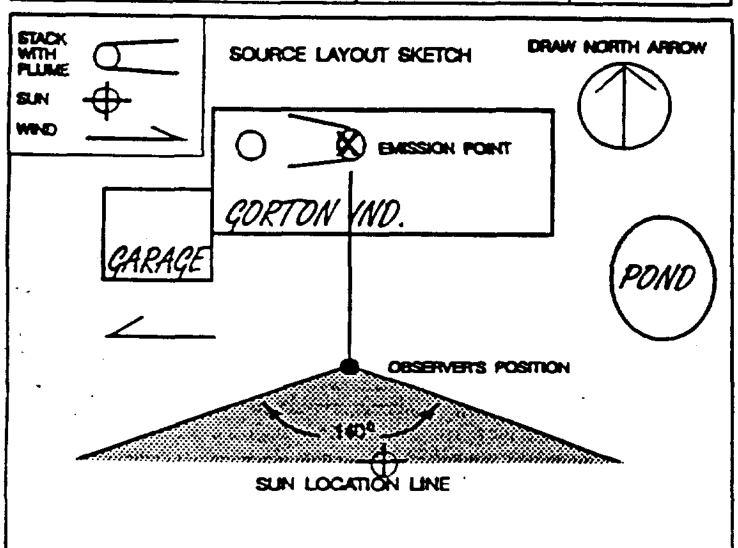
This means that you can select any set of 24 sequential values to construct your final average. The best practice is to construct a screening average (rolling average) of each possible average in the data set and then select the data combinations that you want to calculate. In an hour of observations with no data gaps there are 227 potential averages. Computer programs are available for this calculation or you can construct a spreadsheet with a rolling average to perform the calculation. If you are simply determining noncompliance, you can often scan the data to determine a data set that appears to violate the standard.

A SET DOES NOT HAVE TO START AT THE BEGINNING OF A MINUTE

The set does not have to start at the beginning of a minute; it can start at any point in the observation data. Often this is the difference between compliance and noncompliance.

VISIBLE EMISSION OBSERVATION FORM

COMPANY NAME	GORTON INDUSTRIES
LOCATION	4242 AIKI ROAD
LOCATION	
CITY	SUSQUEHANNA
STATE	PA
ZIP	18847
PROCESS EQUIPMENT	BOILER
OPERATING MODE	90 PERCENT CAPACITY
CONTROL EQUIPMENT	ELECTROSTATIC PRECIPITATOR
OPERATING MODE	RAPPING
DESCRIBE EMISSION POINT	TALLEST OF THREE STACKS, SECOND FROM LEFT FACING NORTH DIAMETER OF 8 FT.
HEIGHT ABOVE GROUND LEVEL	75 FT.
HEIGHT RELATIVE TO OBSERVER	START 50 FT. END SAME
DISTANCE FROM OBSERVER	START 300 ft. END SAME
DIRECTION FROM OBSERVER	START N END SAME
VERTICAL ANGLE TO PLUME	9 DEGREES
HORIZONTAL ANGLE TO PLUME	0 DEGREES
DESCRIBE EMISSIONS	START LOFTING PLUME END SAME
EMISSION COLOR	START WHITE END SAME
IF WATER DROPLET PLUME	ATTACHED ☐ DETACHED ☒ NA ☐
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED	START ONE STACK WIDTH ABOVE OUTLET END SAME
DESCRIBE PLUME BACKGROUND	START MOUNTAIN END SAME
BACKGROUND COLOR	START DARK GREEN END SAME
SKY CONDITIONS	START CLEAR END SCATTERED
WIND SPEED	START 5-7 MPH END 7-9 MPH
WIND DIRECTION	START E END SAME
AMBEINT TEMP	START 65 END 60
WET BULB TEMP	53
RH percent	50



ADDITIONAL INFORMATION

OBSERVATION DATE	FEB 21, 1991
START TIME	1100 EST
END TIME	1125 EST

MIN \ SEC	0	15	30	45	COMMENTS
1	30	35	40	30	
2	25	20	15	30	
3	40	35	40	35	
4	30	30	30	35	
5	30	25	20	30	
6	25	20	15	15	
7	20	35	25	35	
8	30	30	30	25	
9	30	35	40	30	
10	25	20	15	30	
11	40	35	40	35	
12	30	30	30	35	
13	30	25	20	30	
14	25	20	15	15	
15	—	—	25	35	INTERFERING PLUME
16	30	30	30	25	
17	25	20	15	15	
18	20	35	25	35	
19	35	30	30	25	
20	30	35	40	30	
21	25	20	15	30	
22	40	35	40	35	
23	25	20	15	15	
24	20	35	25	35	
25	30	30	30	25	
26					
27					
28					
29					
30					

OBSERVER'S NAME (PRINT)	THOMAS ROSE
OBSERVER'S SIGNATURE	Thomas H. Rose
DATE	FEB 21, 1991
ORGANIZATION	HADLEY ENGINEERING
CERTIFIED BY	EASTERN TECHNICAL ASSOCIATE
DATE	NOV 1, 1990

CONTINUED ON VEO FORM NUMBER

Method 9 states:

For each set of 24 observations, calculate the average by summing the opacity of the 24 observations and dividing this sum by 24.

WHEN THE SIP DOESN'T ADDRESS THE ISSUE, METHOD 9 DATA REDUCTION IS USED

A simple mean is calculated for each data set and each mean is compared to the standard. If any correction is made for pathlength, it must be made before calculating the average.

Method 9 states:

If an applicable standard specifies an averaging time requiring more than 24 observations, calculate the average for all observations made during the specified time period.

Federal standards and SIP opacity regulations sometimes contain averaging times other than 6 minutes. EPA's policy is that if the SIP regulation does not clearly specify an averaging time or other data-reduction technique, the 6-minute average calculations should be used. EPA is currently in the process of providing additional methods to cover alternative averaging times.

Time-Aggregation Standards

Time-aggregation standards are generaly stated in terms of an opacity limit that is not to be exceeded for more than a given time limit, such as 3 minutes, over a total period, such as 1 hour. The usual technique is to count the number of observations that violate the standard during the observation period. Multiply the number of violations by 15 seconds to get the total number of seconds in violation and divide by 60 to get the number of minutes of violation. Compare the answer to the standard. EPA is in the process of promulgating methods that will allow for time-aggregation calculations.

Data Review

Field Data Check

Before you leave the field, look over the form carefully. Start at the bottom right-hand section and work your way up, following the form backwards. Make sure that each section is either filled out correctly or is left blank on purpose. All entries should be legible. Remember, this is the first-generation copy and all subsequent copies will be of lower print quality. As stated earlier in this manual, the visible emission observation form is usually introduced as evidence in enforcement litigation under the principle of "past recollection recorded." This means that you made entries on the form while they were fresh in your mind. A five-minute review at this time can save hours later.

Complete The Form

As soon as possible, gather the missing information and complete the form. Do not sign the form until you have completed all entries you intend to complete.

Method 9 warns:

....are recorded on a field data sheet at the time opacity readings are initiated and completed.

Any additional entries made after you sign the form must be dated and initialed. Failure to document changes properly makes the observations subject to challenge. Even the markout might have to be explained in a deposition or in court.

DESCRIBE EMISSION POINT THIRD T.H.R. 12/15/91 TALLEST OF THREE STACKS, ~~SECOND~~ FROM LEFT FACING NORTH	
DIAMETER OF ~~8~~ 6 FT. T.H.R. 12/15/91	
HEIGHT ABOVE GROUND LEVEL 75 FT.	HEIGHT RELATIVE TO OBSERVER START 50 FT. END SAME
DISTANCE FROM OBSERVER START 300 ft. END SAME	DIRECTION FROM OBSERVER START N END SAME
VERTICAL ANGLE TO PLUME 9 DEGREES	HORIZONTAL ANGLE TO PLUME 0 DEGREES

Quality Assurance Audit

If the form is used as proof of compliance or of violation in a permit application or of agency enforcement action, a third party should review the document in detail. The following sections describe the elements of a minimal audit.

After each item on the form is checked, you should compare related data items for consistency. For example, check if:

- The wind direction arrow in the sketch agrees with the wind direction recorded in the text section of the form.
- The final signature date is consistent with the observation date.
- The time of day is consistent with the sun position.

CERTIFICATION WITHIN 6 MONTHS OF OBSERVATION

Compare the date of the observation at the top of the form with the date of the certification at the bottom of the form. The observation date must be after the certification but no more than 6 months after.

ALL REQUIRED DOCUMENTATION SUPPLIED

Method 9 has specific requirements for recording information regarding the emission source or point observed and the field conditions at the time of the observation. Check to see whether the following information is provided on the VE Observation Form:

- Name of the plant.
- Facility and emission point location.
- Type of facility.
- Observer's name and affiliation.
- Date and time of observation.
- Estimated distance to the emission location.
- Approximate wind direction.
- Estimated wind speed.
- Description of the sky conditions (presence and color of clouds).
- Plume background.
- Sketch of sun, source, and observer positions.
- Distance from the emission outlet to the point in the plume at which the observations are made.
- 24 observations (unless other criteria exist).

If any of these items is missing, it will be pointed out in a deposition, or in a motion before the court, or to the judge when you are on the witness stand.

SUN ANGLE REQUIREMENTS MET

Compliance with sun angle regulations is one of the most difficult items to audit accurately because of inadequate documentation. The angle created by the line of sight of the observer and the line from the sun to the observer must be at least 110°. This places the sun in the 140° cone-shaped sector to the observer's back. Sun angle has both horizontal and vertical components, and both must be reviewed.

Horizontal sun angle is the easiest to check. Compare the direction to the measurement point with the position of the sun at that time of day. If the sun location line on the suggested form is used, this should be easy. If the line looks right, you must still check it against the north arrow in the sketch. You can check the sun location for accuracy using the US Naval Observatory ICE program or solar tables. If all these records are reasonable, you can calculate the horizontal angle. The angle must be at least 110°. Next, check the vertical sun angle. Add the vertical angle of the observer's line of sight to the vertical line of sight to the sun. The total of these two angles must be less than 70°.

VERTICAL, HORIZONTAL, AND COMBINATION SUN ANGLES MUST BE ACCEPTABLE

Lastly, both horizontal and vertical angles must be combined to get the resultant angle. This requires solid trigonometry. Commercial computer programs exist that perform the task. As a general rule, if the total vertical angle is less than 60° and the horizontal angle is above 130°, the resultant angle should be acceptable. Otherwise, the observation is suspect.

SIGHT LINE PERPENDICULAR TO DIRECTION OF PLUME TRAVEL

In order to assure that the sight line was approximately perpendicular to the direction of plume travel, the slant angle should be less than 18°. Use the distance from the stack and the effective stack height to determine the angle. If the plume was horizontal at the point of observation, check the sketch for the direction of plume travel. Then check to see if the plume direction and wind direction are reasonable.

NON-CIRCULAR VENTS READ ACROSS SHORTEST AXIS

Check to see that the plume was observed along a line of sight perpendicular to the long axis of the vent if the vent is not circular. This is important when observing fugitive emissions. Sources such as storage piles, dusty roads, roof monitors, and ships' holds are difficult to observe properly because of this requirement. In many cases you must reach a compromise between the axis of the source and the axis of the plume. If the reading is not made from a position nearly perpendicular to the plume, you should look at the final opacity and determine whether correcting the data for pathlength will still give the same final result in terms of compliance status.

OBSERVATIONAL INTERVALS

Were observations made at 15-second intervals or in compliance with the applicable regulations?

DATA GAPS EXPLAINED

Were a minimum number of observations made with no data gaps? If data gaps exist, are they explained? If an average was calculated with a data gap, what value was assigned to the data gap? What is the reason for selecting the value?

INTERFERENCES CHECKED AND NOTED ON FORM

Check for possible interferences. Obstacles in the line of sight or other emission plumes in front of or behind the plume being monitored create interferences that must be avoided or noted on the data form. Review the sketch for other vents, stacks, or sources of fugitive emissions that might cross the line of sight or co-mingle with the plume being evaluated and create a positive bias in the observations. Compare any photographs to the sketch. The sketch should indicate the backgrounds and their relative distances. If mountains or other distant objects are used as a reading background, check if haze is indicated in the background section. This will potentially create a negative bias in the opacity readings. Also, note in the comments section beside the observation whether interferences were reported. Lastly, check the additional information section and the data section for comments regarding haze or other interferences.

STEAM PLUMES NOTED AND PROPER PROCEDURES FOLLOWED

Was the emission observed at a point where there was no condensed water? If the form indicates the presence of a steam plume, pay special attention to the point in the plume where the observation was made. Does it make sense in relation to instructions given in sections 2.3, 2.3.1, and 2.3.2 of the Method 9? Check the ambient temperature and relative humidity, if available. If the temperature is low or if the relative humidity is high (over 70 percent), consider the possibility of a steam plume that does not evaporate easily. If the data are available, model the steam plume using the technique in EPA Quality Assurance Handbook, Volume III, Section 3.12. When you use this model you must recognize that:

- The charts were developed from steam tables to represent the conditions in an ideal closed system, and the atmosphere is not an ideal closed system.
- The tables do not consider the presence of particulate matter or condensation nuclei.
- The temperature of the emission gases is an average of at least a one-hour emission test and does not necessarily represent a steady-state condition in the stack.
- The moisture content entered into the calculation is an average of at least one hour and might not be representative of the plume conditions over a shorter time frame. The chart does not recognize that the plume might not be uniform in moisture concentration and that some portions of the plume might be at supersaturation.
- The tables do not consider the presence of hygroscopic particulate matter that could attract and hold onto water by lowering its vapor pressure.

The chart is best used by constructing a line with an error band that recognizes the associated error in measurement of each of the input parameters. It should be assumed that no water plume forms only if the error band does not approach the dewpoint.

DATA REDUCTION AND REPORTING PREFORMED IN ACCORDANCE WITH REGULATION

Are the calculations in compliance with the regulation? Does the regulation require averaging over a time period other than 6 minutes? Does it require time aggregation? Is the math correct? Was the highest average determined? Is there data showing noncompliance in excess of the regulation in terms of opacity and time?

OPACITY READINGS REPRESENTATIVE OF ACTUAL CONDITIONS

Verify that no interferences or extenuating circumstances existed during the observation that would make the opacity values not representative of actual conditions or otherwise invalidate the observation.

REPEAT THE AUDIT

Depending upon the potential use of the form, it may be wise to have an additional third party audit the form. After completing the second audit, compare the results of the two independent audits and resolve any outstanding difficulties.

Further Readings

Field Observation Procedures:

Quality Assurance Handbook for Air Pollution Measurement Systems: Vol. III Stationary source Specific Methods, Section 3.12 — Method 9 Visible Determination of Opacity of Emissions from Stationary Sources, EPA 600/4-77-027b, February 1984.

Guidelines for Evaluation of Visible Emissions: Certification, Field Procedures, Legal Aspects and Background Materials, EPA 340/1-75-007, April 1975.

Guide to Effective Inspection Reports for Air Pollution Violations, EPA 340/1-85-019, September 1985.

Instructions for Use of the VE Observations Form, EPA 340/1-86-017.

Observer Training and Certification:

Self-Audit Guide for Visible Emission Training and Certification Programs, EPA 455/R-92-005.

Technical Assistance Document: Quality Assurance Guideline for Visible Emission Training Schools, EPA 600/4-83-011.

Course 325 — Visible Emission Evaluation: Student Manual, EPA 455/B-93-011a, January 1994.

Opacity Evaluation Methods:

Optical Properties and Visual Effects of Smoke-Stack Plumes, AP-30, Revised May 1972.

Evaluation and Collaborative Study of Method for Visual Determination of Opacity of Emissions from Stationary Sources, EPA 650/4-75-009, January 1975.

Measurement of the Opacity and Mass Concentration of Particulate Emissions by Transmissometry, EPA 650/2-74-128, November 1974.

Appendix A

Forms

VISIBLE EMISSION OBSERVATION FORM

COMPANY NAME

LOCATION

LOCATION

CITY | STATE | ZIP

PROCESS EQUIPMENT | OPERATING MODE

CONTROL EQUIPMENT | OPERATING MODE

DESCRIBE EMISSION POINT

HEIGHT ABOVE GROUND LEVEL

HEIGHT RELATIVE TO OBSERVER
START END

DISTANCE FROM OBSERVER
START END

DIRECTION FROM OBSERVER
START END

VERTICAL ANGLE TO PLUME

HORIZONTAL ANGLE TO PLUME

DESCRIBE EMISSIONS
START END

EMISSION COLOR
START END

IF WATER DROPLET PLUME
ATTACHED ☐ DETACHED ☐ NA ☐

POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED
START END

DESCRIBE PLUME BACKGROUND
START END

BACKGROUND COLOR
START END

SKY CONDITIONS
START END

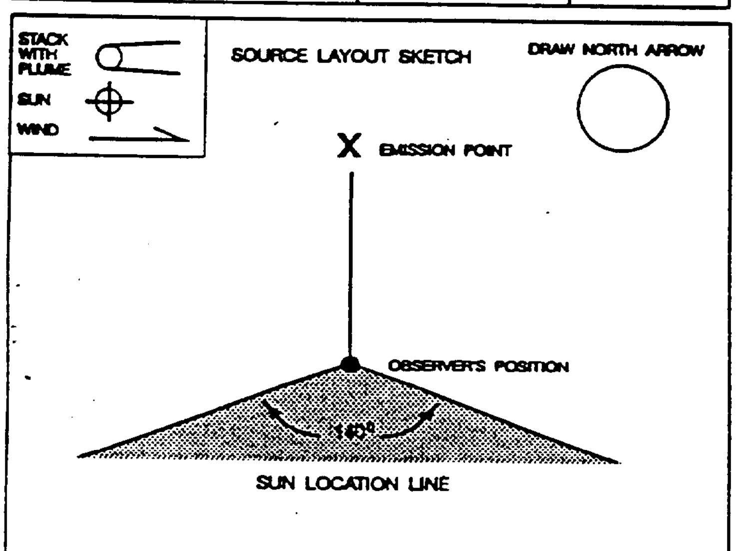
WIND SPEED
START END

WIND DIRECTION
START END

AMBEINT TEMP
START END

WET BULB TEMP

RH percent



ADDITIONAL INFORMATION

OBSERVATION DATE	START TIME	END TIME

SEC / MIN	0	15	30	45	COMMENTS
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					

OBSERVER'S NAME (PRINT)

OBSERVER'S SIGNATURE | DATE

ORGANIZATION

CERTIFIED BY | DATE

CONTINUED ON VEO FORM NUMBER

FUGITIVE OR SMOKE EMISSION INSPECTION OUTDOOR LOCATION

Company ______ Location ______ Company Rep. ______	Observer ______ Affiliation ______ Date ______
Sky Conditions ______ Precipitation ______	Wind Direction ______ Wind Speed ______
Industry ______	Process Unit ______

Sketch process unit: indicate observer position relative to source and sun, indicate potential emission points and/or actual emission points.

OBSERVATIONS

	Clock time	Observation period duration, min:sec	Accumulated emission time, min:sec
Begin Observation	______		
	______	______	______
	______	______	______
	______	______	______
	______	______	______
	______	______	______
	______	______	______
	______	______	______
	______	______	______
End Observation	______	______	______

Figure 22-1

FUGITIVE EMISSION INSPECTION
INDOOR LOCATION

Company ______________ Observer ______________

Location ______________ Affiliation ______________

Company Rep. ______________ Date ______________

Industry ______________ Process Unit ______________

Light type(fluorescent,incandescent,natural) ______________

Light location(overhead,behind observr etc) ______________

Illuminance(lux or footcandles) ______________

Sketch process unit: Indicate observer position relative to source; indicate potential emission points and/or actual emission points.

OBSERVATIONS

	Clock time	Observation period duration, min:sec	Accumulated emission time, min:sec
Begin Observation	______	______	______
	______	______	______
	______	______	______
	______	______	______
	______	______	______
	______	______	______
	______	______	______
	______	______	______
	______	______	______
End Observation	______	______	______

Figure 22-2

Photo Log

Roll # ______________________________

#	Time/Date	Subject
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		

Appendix B

Method 9 - Visual Determination of the Opacity of Emissions from Stationary Sources

Introduction

(a) Many stationary sources discharge visible emissions into the atmosphere; these emissions are usually in the shape of a plume. This method involves the determination of plume opacity by qualified observers. The methods includes procedures for the training and certification of observers and procedures to be used in the field for determination of plume opacity.

(b) The appearance of a plume as viewed by an observer depends upon a number of variables, some of which may be controllable in the field. Variables which can be controlled to an extent to which they no longer exert a significant influence upon plume appearance include: angle of the observer with respect to the plume; angle of the observer with respect to the sun; point of observation of attached and detached steam plume; and angle of the observer with respect to a plume emitted from a rectangular stack with a large length to width ratio. The method includes specific criteria applicable to these variables.

(c) Other variables which may not be controllable in the field are luminescence and color contrast between the plume and the background against which the plume is viewed. These variables exert an influence upon the appearance of a plume as viewed by an observer and can affect the ability of the observer to assign accurately opacity values to the observed plume. Studies of the theory of plume opacity and field studies have demonstrated that a plume is most visible and presents the greatest apparent opacity when viewed against a contrasting background. Accordingly, the opacity of a plume viewed under conditions where a contrasting background is present can be assigned with the greatest degree of accuracy. However, the potential for a positive error is also the greatest when a plume is viewed under such contrasting conditions. Under conditions presenting a less contrasting background, the apparent opacity of a plume is less and approaches zero as the color and luminescence contrast decrease toward zero. As a result, significant negative bias and negative errors can be made when a plume is viewed under less contrasting conditions. A negative bias decreases rather than increases the possibility that a plant operator will be incorrectly cited for a violation of opacity standards as a result of observer error.

(d) Studies have been undertaken to determine the magnitude of positive errors made by qualified observers while reading plumes under contrasting conditions and using the procedures set forth in this method. The results of these studies (field trials) which involve a total of 769 sets of 25 readings each are as follows:
(1) For black plumes (133 sets at a smoke generator), 100 percent of the sets were read with a positive error of less than 7.5 percent opacity; 99 percent were read with a positive error of less than 5 percent opacity. (Note: For a set, positive error = average opacity determined by observers' 25 observations -average opacity determined from transmissometer's 25 recordings.)

(2) For white plumes (170 sets at a smoke generator, 168 sets at a coal-fired power plant, 298 sets at a sulfuric acid plant), 99 percent of the sets were read with a positive error of less than 7.5 percent opacity; 95 percent were read with a positive error of less than 5 percent opacity.

(e) The positive observational error associated with an average of twenty-five readings is therefore established. The accuracy of the method must be taken into account when determining possible violations of applicable opacity standards.

1. Principle And Applicability

1.1 Principle. The opacity of emissions from stationary sources is determined visually by a qualified observer.

1.2 Applicability. This method is applicable for the determination of the opacity of emissions from stationary sources pursuant to § 60.11(b) and for visually determining opacity of emissions.

2. Procedures

The observer qualified in accordance with Section 3 of this method shall use the following procedures for visually determining the opacity of emissions.

2.1 Position. The qualified observer shall stand at a distance sufficient to provide a clear view of the emissions with the sun oriented in the 140° sector to his back. Consistent with maintaining the above requirement, the observer shall, as much as possible, make his observations from a position such that his line of vision is approximately perpendicular to the plume direction and, when observing opacity of emissions

from rectangular outlets (e.g., roof monitors, open baghouses, noncircular stacks), approximately perpendicular to the longer axis of the outlet. The observer's line of sight should not include more than one plume at a time when multiple stacks are involved, and in any case the observer should make his observations with his line of sight perpendicular to the longer axis of such a set of multiple stacks (e.g., stub stacks on baghouses).

2.2 Field Records. The observer shall record the name of the plant, emission location, facility type, observer's name and affiliation, a sketch of the observer's position relative to the source, and the date on a field data sheet (Figure 9-1). The time, estimated distance to the emission location, approximate wind direction, estimated wind speed, description of the sky condition (presence and color of clouds), and plume background are recorded on a field data sheet at the time opacity readings are initiated and completed.

2.3 Observations. Opacity observations shall be made at the point of greatest opacity in that portion of the plume where condensed water vapor is not present. The observer shall not look continuously at the plume but instead shall observe the plume momentarily at 15-second intervals.

2.3.1 Attached Steam Plumes. When condensed water vapor is present within the plume as it emerges from the emission outlet, opacity observations shall be made beyond the point in the plume at which condensed water vapor is no longer visible. The observer shall record the approximate distance from the emission outlet to the point in the plume at which the observations are made.

2.3.2 Detached Steam Plume. When water vapor in the plume condenses and becomes visible at a distinct distance from the emission outlet, the opacity of emissions should be evaluated at the emission outlet prior to the condensation of water vapor and the formation of the steam plume.

2.4 Recording Observations. Opacity observations shall be recorded to the nearest 5 percent at 15-second intervals on an observational record sheet. (See Figure 9-2 for an example.) A minimum of 24 observations shall be recorded. Each momentary observation recorded shall be deemed to represent the average opacity of emissions for a 15-second period.

2.5 Data Reduction. Opacity shall be determined as an average of 24 consecutive observations recorded at 15-second intervals. Divide the observations recorded on the record sheet into sets of 24 consecutive observations. A set is composed of any 24 consecutive observations. Sets need not be consecutive in time and in no case shall two sets overlap. For each set of 24 observations, calculate the average by summing the opacity of the 24 observations and dividing this sum by 24. If an applicable standard specifies an averaging time requiring more than 24 observations, calculate the average for all observations made during the specified time period. Record the average opacity on a record sheet. (See Figure 9-1 for an example.)

3. Qualification and Testing

3.1 Certification Requirements. To receive certification as a qualified observer, a candidate must be tested and demonstrate the ability to assign opacity readings in 5 percent increments to 25 different black plumes and 25 different white plumes, with an error not to exceed 15 percent opacity on any one reading and average error not to exceed 7.5 percent opacity in each category. Candidates shall be tested according to the procedures described in Section 3.2. Smoke generators used pursuant to Section 3.2 shall be equipped with a smoke meter which meets the requirements of Section 3.3. The certification shall be valid for a period of 6 months, at which time the qualification procedure must be repeated by any observer in order to retain certification.

3.2 Certification Procedure. The certification test consists of showing the candidate a complete run of 50 plumes–25 black plumes and 25 white plumes-generated by a smoke generator. Plumes within each set of 25 black and 25 white runs shall be presented in random order. The candidate assigns an opacity value to each plume and records his observation on a suitable form. At the completion of each run of 50 readings, the score of the candidate is determined. If a candidate fails to qualify, the complete run of 50 readings must be repeated in any retest. The smoke test may be administered as part of a smoke school or training program and may be preceded by training or familiarization runs of the smoke generator during which candidates are shown black and white plumes of known opacity.

3.3 Smoke Generator Specifications. Any smoke generator used for the purposes of Section 3.2 shall be equipped with a smoke meter installed to measure opacity across the diameter of the smoke generator stack. The smoke meter output shall display in-stack opacity based upon a pathlength equal to the stack exit diameter, on a full 0 to 100 percent chart recorder scale. The smoke meter optical design and performance shall meet the specifications shown in Table 9-1. The smoke meter shall be calibrated as prescribed in Section 3.3.1 prior to the conduct of each smoke reading test. At the completion of each test, the zero and span drift shall be checked and if the drift exceeds ±1 percent opacity, the condition shall be corrected prior to conducting any subsequent test runs. The smoke meter shall be demonstrated, at the time of installation, to meet the specifications listed in Table 9-1. This demonstration shall be repeated following any subsequent repair or replacement of the photocell or associated electronic circuitry including the chart recorder or output meter, or every 6 months, whichever occurs first.

3.3.1 Calibration. The smoke meter is calibrated after allowing a minimum of 30 minutes warmup by alternately producing simulated opacity of 0 percent and 100 percent. When stable response at 0 percent or 100 percent is noted, the smoke meter is adjusted to produce an output of 0 percent or 100 percent, as appropriate. This calibration shall be repeated until stable 0 percent and 100 percent opacity values may be produced by alternately switching the power to the light source on and off while the smoke generator is not producing smoke.

3.3.2 Smoke Meter Evaluation. The smoke meter design and performance are to be evaluated as follows:

3.3.2.1 Light Source. Verify from manufacturer's data and from voltage measurements made at the lamp, as installed, that the lamp is operated within ±5 percent of the nominal rated voltage.

3.3.2.2 Spectral Response of Photocell. Verify from manufacturer's data that the photocell has a photopic response; i.e., the spectral sensitivity of the cell shall closely approximate the standard spectral-luminosity in (b) of Table 9-1.

3.3.2.3 Angle of View. Check construction geometry to ensure that the total angle of view of the smoke plume, as seen by the photocell, does not exceed 15°. The total angle of view may be calculated from: $\grave{E} = 2 \tan^{-1}(d/2L)$, where $\grave{E}$ = total angle of view; d = the sum of the photocell diameter + the diameter of the limiting aperture; and L = the distance from the photocell to the limiting aperture. The limiting aperture is the point in the path between the photocell and the smoke plume where the angle of view is most restricted. In smoke generator smoke meters this is normally an orifice plate.

3.3.2.4 Angle of Projection. Check construction geometry to ensure that the total angle of projection of the lamp on the smoke plume does not exceed 15°. The total angle of projection may be calculated from: $\grave{E} = 2 \tan^{-1}(d/2L)$, where $\grave{E}$ = total angle of projection; d = the sum of the length of the lamp filament + the diameter of the limiting aperture; and L = the distance from the lamp to the limiting aperture.

3.3.2.5 Calibration Error. Using neutral-density filters of known opacity, check the error between the actual response and the theoretical linear response of the smoke meter. This check is accomplished by first calibrating the smoke meter according to Section 3.3.1 and then inserting a series of three neutral-density filters of nominal opacity of 20, 50, and 75 percent in the smoke meter pathlength. Filters calibrated within 2 percent shall be used. Care should be taken when inserting the filters to prevent stray light from affecting the meter. Make a total of five nonconsecutive readings for each filter. The maximum error on any one reading shall be 3 percent opacity.

3.3.2.6 Zero and Span Drift. Determine the zero and span drift by calibrating and operating the smoke generator in a normal manner over a 1-hour period. The drift is measured by checking the zero and span at the end of this period.

3.3.2.7 Response Time. Determine the response time by producing the series of five simulated 0 percent and 100 percent opacity values and observing the time required to reach stable response. Opacity values of 0 percent and 100 percent may be simulated by alternately switching the power to the light source off and on while the smoke generator is not operating.

Table 9-1. Smoke Generator Design And Performance Specifications		
	Parameter	Specification
a.	Light source	Incandescant lamp operated at nominal rated voltage
b.	Spectral response of photocell	Photopic (daylight spectral response of the human eye --Citation 3)
c.	Angle of view	15 1/2 maximum total angle
d.	Angle of projection	15 1/2 maximum total angle
e.	Calibration error	± 3 % opacity, maximum
f.	Zero and span drift	± 1 % opacity, 30 minutes
g.	Response time	± 5 seconds

Bibliography

1. Air Pollution Control District Rules and Regulations, Los Angeles County Air Pollution Control District, Regulation IV, Prohibitions, Rule 50.

2. Weisburd, Melvin I., Field Operations and Enforcement Manual for Air, U.S. Environmental Protection Agency, Research Triangle Park, NC, APTD-1100, August 1972, pp. 4.1-4.36.

3. Condon. E.U., and Odishaw, H., Handbook of Physics, McGraw-Hill Co., New York, NY, 1958, Table 3.1, p. 6-52.

Figure 9-1. Record of Visual Determination of Opacity

Company ______________________

Location ______________________

Test No. ______________________

Date ______________________

Type Facility ______________________

Control Device ______________________

Hours of Observation ______________________

Observer ______________________

Observer Certification Date ______________ Observer Affiliation ______________

Point of Emissions ______________ Height of Discharge Point ______________

Clock Time	Initial			Final
Observer Location Distance to Discharge				
Direction from Discharge				
Height of Observation Point				
Background Description				
Weather Description Wind Direction				
Wind Speed				
Ambient Temperature				
Sky Conditions (clear, overcast, % clouds, etc.)				
Plume Description Color				
Distance Visible				
Other Information				

SUMMARY OF AVERAGE OPACITY

Set Number	Time	Opacity	
	Start - End	Sum	Average

Figure 9-2. Observation Record

Page _____ of _____

Company ______________________ Observer ______________________

Location ______________________ Type Facility ______________________

Test Number ______________________ Point of Emissions ______________________

		Seconds				Steam Plume (Check if applicable)		Comments
Hr	Min	0	15	30	45	Attached	Detached	
	0							
	1							
	2							
	3							
	4							
	5							
	6							
	7							
	8							
	9							
	10							
	11							
	12							
	13							
	14							
	15							
	16							
	17							
	18							
	19							
	20							
	21							
	22							
	23							
	24							
	25							
	26							
	27							
	28							
	29							

Figure 9-2. Observation Record (continued)

Page ______ of ______

Company ______________________ Observer ______________________
Location ______________________ Type Facility ______________________
Test Number ______________________ Point of Emissions ______________________

Seconds						Steam Plume (Check if applicable)		Comments
Hr	Min	0	15	30	45	Attached	Detached	
	30							
	31							
	32							
	33							
	34							
	35							
	36							
	37							
	38							
	39							
	40							
	41							
	42							
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	57							
	58							
	59							

Appendix C

Method 22 - Visual Determination of Fugitive Emissions from Material Sources and Smoke Emissions from Flares

1. Introduction

1.1 This method involves the visual determination of fugitive emissions, i.e., emissions not emitted directly from a process stack or duct. Fugitive emissions include emissions that (1) escape capture by process equipment exhaust hoods; (2) are emitted during material transfer; (3) are emitted from buildings housing material processing or handling equipment; and (4) are emitted directly from process equipment. this method is used also to determine visible smoke emissions from flares used for combustion of waste process materials.

1.2 This method determines the amount of time that any visible emissions occur during the observation period, i.e., the accumulated emission time. This method does not require that the opacity of emissions be determined. Since this procedure requires only the determination of whether a visible emission occurs and does not require the determination of opacity levels, observer certification according to the procedures of Method 9 are not required. However, it is necessary that the observer is educated on the general procedures for determining the presence of visible emissions. As a minimum, the observer must be trained and knowledgeable regarding the effects on the visibility of emissions caused by background contrast, ambient lighting, observer position relative to lighting, wind, and the presence of uncombined water (condensing water vapor). This training is to be obtained from written materials found in Citations 1 and 2 in the Bibliography or from the lecture portion of the Method 9 certification course.

2. Applicability And Principle

2.1 Applicability.

2.1.1 This method applies to the determination of the frequency of fugitive emissions from stationary sources (located indoors or outdoors) when specified as the test method for determining compliance with new source performance standards.

2.1.2 This method also is applicable for the determination of the frequency of visible smoke emissions from flares.

2.2 Principle. Fugitive emissions produced during material processing, handling, and transfer operations or smoke emissions from flares are visually determined by an observer without the aid of instruments.

3. Definitions

3.1 Emission Frequency. Percentage of time that emissions are visible during the observation period.

3.2 Emission Time. Accumulated amount of time that emissions are visible during the observation period.

3.3 Fugitive Emissions. Pollutant generated by an affected facility which is not collected by a capture system and is released to the atmosphere.

3.4 Smoke Emissions. Pollutant generated by combustion in a flare and occurring immediately downstream of the flame. Smoke occurring within the flame, but not downstream of the flame, is not considered a smoke emission.

3.5 Observation Period. Accumulated time period during which observations are conducted, not to be less than the period specified in the applicable regulation.

4. Equipment

4.1 Stopwatches. Accumulative type with unit divisions of at least 0.5 seconds; two required.

4.2 Light Meter. Light meter capable of measuring illuminance in the 50 to 200-lux range, required for indoor observations only.

5. Procedure

5.1 Position. Survey the affected facility or building or structure housing the process to be observed and determine the locations of potential emissions. If the affected facility is located inside a building, determine an observation location that is consistent with the requirements of the applicable regulation (i.e., outside observation of emissions escaping the building/structure or inside observation of emissions directly emitted from the affected facility process unit). Then select a position that enables a clear view of the potential emission point(s) of the affected facility or of the building or structure housing the affected, as appropriate for the

applicable subpart. A position at least 15 feet, but not more than 0.25 miles, from the emission source is recommended. For outdoor locations, select a position where the sun is not directly in the observer's eyes.

5.2 Field Records.

5.2.1 Outdoor Location. Record the following information on the field data sheet (Figure 22-1): Company name, industry, process unit, observer's name, observer's affiliation, and date. Record also the estimated wind speed, wind direction, and sky condition. Sketch the process unit being observed, and note the observer location relative to the source and the sun. Indicate the potential and actual emission points on the sketch.

5.2.2 Indoor Location. Record the following information on the field data sheet (Figure 22-2): Company name, industry, process unit, observer's name, observer's affiliation, and date. Record as appropriate the type, location, and intensity of lighting on the data sheet. Sketch the process unit being observed, and note observer location relative to the source. Indicate the potential and actual fugitive emission points on the sketch.

5.3 Indoor Lighting Requirements. for indoor locations, use a light meter to measure the level of illumination at a location as close to the emission sources(s) as is feasible. An illumination of greater than 100 lux (10 foot candles) is considered necessary for proper application of this method.

5.4 Observations. Record the clock time when observations begin. Use one stopwatch to monitor the duration of the observation period; start this stopwatch when the observation period begins. If the observation period is divided into two or more segments by process shutdowns or observer rest breaks, stop the stopwatch when a break begins and restart it without resetting when the break ends. Stop the stopwatch at the end of the observation period. The accumulated time indicated by this stopwatch is the duration of observation period. When the observation period is completed, record the clock time. During the observation period, continuously watch the emission source. Upon observing an emission (condensed water vapor is not considered an emission), start the second accumulative stopwatch; stop the watch when the emission stops. Continue this procedure for the entire observation period. The accumulated elapsed time on this stopwatch is the total time emissions were visible during the observation period, i.e., the emission time.

5.4.1 Observation Period. Choose an observation period of sufficient length to meet the requirements for determining compliance with the emission regulation in the applicable subpart. When the length of the observation period is specifically stated in the applicable subpart, it may not be necessary to observe the source for this entire period if the emission time required to indicate noncompliance (based on the specified observation period) is observed in a shorter time period. In other words, if the regulation prohibits emissions for more than 6 minutes in any hour, then observations may (optional) be stopped after an emission time of 6 minutes is exceeded. Similarly, when the regulation is expressed as an emission frequency and the regulation prohibits emissions for greater than 10 percent of the time in any hour, then observations may (optional) be terminated after 6 minutes of emission are observed since 6 minutes is 10 percent of an hour. In any case, the observation period shall not be less than 6 minutes in duration. In some cases, the process operation may be intermittent or cyclic. In such cases, it may be convenient for the observation period to coincide with the length of the process cycle.

5.4.2 Observer Rest Breaks. Do not observe emissions continuously for a period of more than 15 to 20 minutes without taking a rest break. For sources requiring observation periods of greater than 20 minutes, the observer shall take a break of not less than 5 minutes and not more than 10 minutes after every 15 to 20 minutes of observation. If continuous observations are desired for extended time periods, two observers can alternate between making observations and taking breaks.

5.4.3 Visual Interference. Occasionally, fugitive emissions from sources other than the affected facility (e.g., road dust) may prevent a clear view of the affected facility. This may particularly be a problem during periods of high wind. If the view of the potential emission points is obscured to such a degree that the observer questions the validity of continuing observations, then the observations are terminated, and the observer clearly notes this fact on the data form.

5.5 Recording Observations. Record the accumulated time of the observation period on the data sheet as the observation period duration. Record the accumulated time emissions were observed on the data sheet as the emission time. Record the clock time the observation period began and ended, as well as the clock time any observer breaks began and ended.

6. Calculations

If the applicable subpart requires that the emission rate be expressed as an emission frequency (in percent), determine this value as follows: Divide the accumulated emission time (in seconds) by the duration of the observation period (in seconds) or by any minimum observation period required in the applicable subpart, if the actual observation period is less than the required period, and multiply this quotient by 100.

Bibliography

1. Missan, Robert and Arnold Stein. Guidelines for Evaluation of Visible Emissions Certification, Field Procedures, Legal Aspects, and Background Material. EPA Publication No. EPA-340/1-75-007. April 1975.

2. Wohlschlegel, P., and D.E. Wagoner. Guideline for Development of a Quality Assurance Program: Volume IX–Visual Determination of Opacity Emissions from Stationary Sources. EPA Publication No. EPA-650/4-74-005i. November 1975.

FUGITIVE OR SMOKE EMISSION INSPECTION
OUTDOOR LOCATION

Company ______ Location ______ Company Rep. ______	Observer ______ Affiliation ______ Date ______
Sky Conditions ______ Precipitation ______	Wind Direction ______ Wind Speed ______
Industry ______	Process Unit ______

Sketch process unit: indicate observer position relative to source and sun, indicate potential emission points and/or actual emission points.

OBSERVATIONS

	Clock time	Observation period duration, min:sec	Accumulated emission time, min:sec
Begin Observation	______	______	______
	______	______	______
	______	______	______
	______	______	______
	______	______	______
	______	______	______
	______	______	______
	______	______	______
	______	______	______
End Observation	______		

Figure 22-1

FUGITIVE EMISSION INSPECTION
INDOOR LOCATION

Company ______________________ Observer ______________________

Location ______________________ Affiliation ______________________

Company Rep. ______________________ Date ______________________

Industry ______________________ Process Unit ______________________

Light type(fluorescent,incandescent,natural) ______________________

Light location(overhead,behind observr etc) ______________________

Illuminance(lux or footcandles) ______________________

Sketch process unit: Indicate observer position relative to source; indicate potential emission points and/or actual emission points.

OBSERVATIONS

	Clock time	Observation period duration, min:sec	Accumulated emission time, min:sec
Begin Observation			
End Observation			

Figure 22-2

Appendix D:

EPA Method 9 Opacity Monitoring Form

EPA METHOD 9 (40 CFR 60 - Appendix A)
VISIBLE EMISSION OBSERVATION FORM

COMPANY NAME

LOCATION

LOCATION

CITY	STATE	ZIP

PROCESS EQUIPMENT	OPERATING MODE
CONTROL EQUIPMENT	OPERATING MODE

DESCRIBE EMISSION POINT

HEIGHT OF EMISSION POINT	HEIGHT OF EMISSION POINT RELATIVE TO OBSERVER START END
DISTANCE TO EMISSION POINT START END	DIRECTION TO EMISSION PT. (DEGREES 0-360)) START END
VERTICAL ANGLE TO OBSERVATION POINT START END	DIRECTION TO OBSERVATION POINT (DEGREES (0-360)) START END

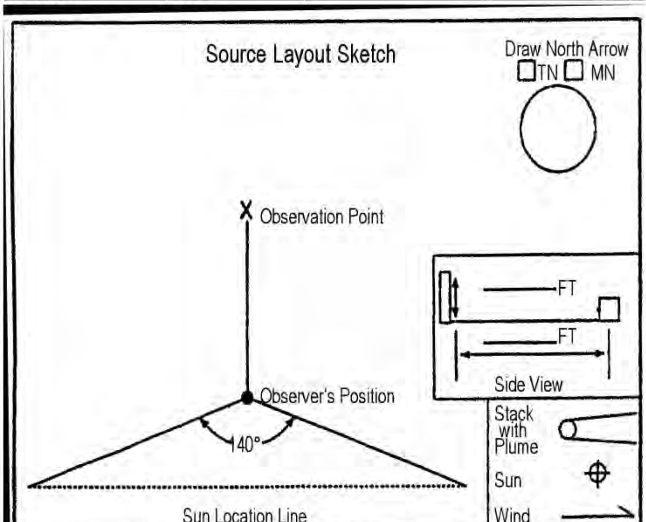
DISTANCE & DIRECTION TO OBSERVATION POINT FROM EMISSION POINT
START END

DESCRIBE EMISSIONS
START END

EMISSION COLOR START END	WATER DROPLET PLUME ATTACHED ☐ DETACHED ☐ NONE ☐

DESCRIBE PLUME BACKGROUND
START END

BACKGROUND COLOR START END	SKY CONDITIONS START END
WIND SPEED START END	WIND DIRECTION START END
AMBIENT TEMP START END	WET BULB TEMP RH percent



ADDITIONAL INFORMATION

OBSERVATION DATE	START TIME	END TIME

MIN \ SEC	0	15	30	45	COMMENTS
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
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14					
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28					
29					
30					

OBSERVER'S NAME (PRINT)

OBSERVER'S SIGNATURE	DATE

ORGANIZATION

CERTIFIED BY	DATE

Appendix E:

EPA Method 22 Visible Emissions Form

FUGITIVE OR SMOKE EMISSION INSPECTION
OUTDOOR LOCATION

Company	Observer
Location	Affiliation
Company Rep.	Date
Sky Conditions	Wind Direction
Precipitation	Wind Speed
Industry	Process Unit

Sketch process unit: indicate observer position relative to source; indicate potential emission points and/or actual emission points.

OBSERVATIONS	Clock Time	Observation period duration, minutes:seconds	Accumulated emission time, minutes:seconds
Begin Observation			
To complete this form, record the following: • the initial clock time • the total time of the observation (from SW1) • the total time of emissions (from SW2), and • the final clock time. For more details on recording this data and taking breaks, see #7 and #10 above.			
End Observation			